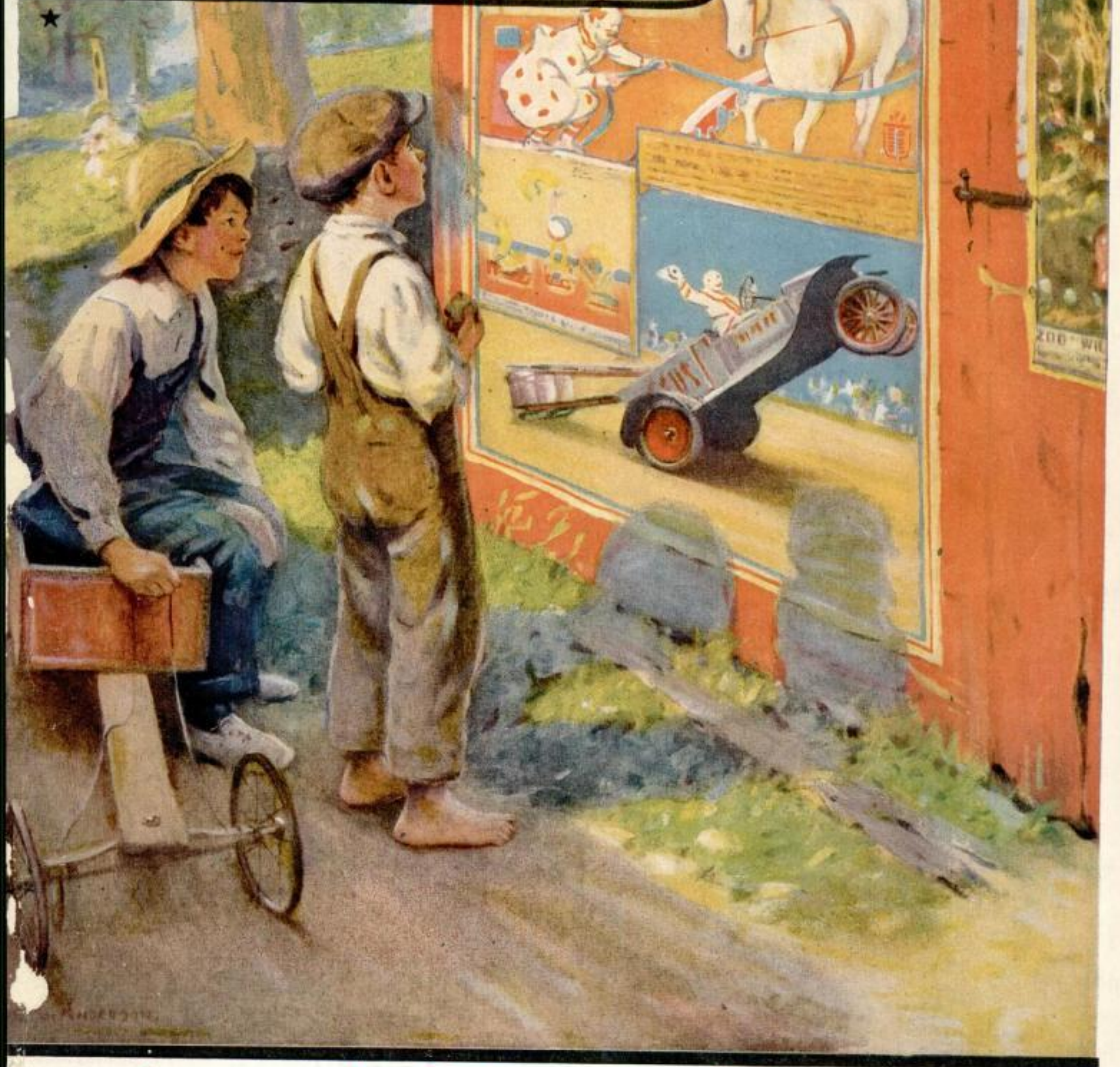


Popular Science

FOUNDED MONTHLY 1872



Wonders of Science Harnessed
for Circus Thrills



For Summer Sport

Radiola RC

Solid mahogany; complete with three tubes, six batteries, headset and plug—
\$142.50

- Radiola RC

Down to the beach again—into the water—out on the boats. And every party a Radiola party, with concerts and dance music coming in on the air.

Off to the camps again—deep woods—canoes on the lake—roasted corn. And a campfire. With a Radiola to bring in music from cities a thousand miles away.

Baseball again—and the scores broadcasted to your Radiola in the backwoods. Quiet days of rest, but not dull days. Rainy days indoors, but days of fun. Fun all day, every day, with Radiola RC.



The porch sewing circle listens in, with Radiola RC. Probably a fashion talk.



Canoes—moonlight—and Radiola RC. Rippling waters—rippling melodies—stars—'n' every thing.



The camp gets the baseball news by radio. There's no excitement like it!



This symbol of quality is your protection

A letter from Franklin, Pa.
"Gentlemen: We heard a concert broadcasted from a ship 2500 miles out on the Atlantic Ocean, with a Radiola RC. The piano was beautiful, just as clear as if it were in the room.

Very truly yours,
G. W. HANLON"

"There's a Radiola for every purse"

at the nearest Radio or Electrical Store

Radio Corporation of America

Sales Department
233 Broadway, New York

District Sales Offices
10 So. LaSalle St., Chicago, Ill. 433 California St., San Francisco, Cal.

Radiola

REG. U. S. PAT. OFF.

RADIO CORPORATION OF AMERICA,
Dept. 2080 (address nearest office listed above)
Please send me your free Radio Booklet.

Name _____
Street Address _____
City _____ R. F. D. _____
State _____



Victrola VI
\$35
Mahogany or oak



Victrola No. 50
\$50
Mahogany or oak



Victrola IX
\$75
Mahogany or oak



Victrola No. 220
\$200
Victrola No. 220, electric,
\$240
Mahogany or walnut



Victrola No. 240
\$115
Mahogany or walnut



Victrola No. 100
\$150
Mahogany or walnut

Select the style you prefer but be sure it is a Victrola!

There are no better judges of performance than those who themselves perform. Practically without exception, all those who represent most in the world of musical art choose the Victrola as the one best instrument to perpetuate their achievements. The purchase of a Victrola therefore carries with it assurances of satisfaction which can be obtained in no other music-reproducing instrument.

Hear these Victor Records by the world's most famous artists:

For You Alone	Caruso	87070	\$1.25
Song of the Volga Boatmen	Chaliapin	88663	1.75
Ol' Car'lina	Galli-Curci	66014	1.25
My Laddie	Gluck	64183	1.25
Caprice Viennois <i>Violin</i>	Kreisler	74197	1.75
Mother Machree	McCormack	64181	1.25
Good-Bye	Melba	88065	1.75
Hungarian Rhapsody, No. 10 <i>Piano</i>	Paderewski	74788	1.75
Spinning Song <i>Piano</i>	Rachmaninoff	64921	1.25
Danny Boy	Schumann-Heink	88592	1.75

Go to the nearest dealer in Victor products and ask him to play these records for you. They are representative of the great Victor Catalog. You will be thrilled by their music and realize as you never have before your need of such music as the Victrola and Victor Records used together can produce.



Victrola

Look for these trade-marks. Under the lid. On the label.
Victor Talking Machine Company, Camden, N.J.

POPULAR SCIENCE MONTHLY

JULY, 1923; Vol. 103, No. 1
25 cents a Copy; \$2.50 a Year



Published in New York City at
225 West Thirty-ninth Street

SCIENCE never stands still. Progress is its underlying law. Because of its discoveries and inventions, human life is changing constantly. To realize the extent of this change one need only turn to "The Story of Man and His World," page 32 of this issue. In it Dr. E. E. Free, noted scientific writer, pictures vividly the thousands of years since human cooperation began. He tells how Maturity has gathered knowledge and passed it on to Youth. Yet, despite this vast accumulation of knowledge, signs everywhere indicate that in science and invention we have just begun.

* * *

POPULAR SCIENCE MONTHLY translates the wonders of science into terms that apply personally to the average man. This magazine is edited to serve its readers in the everyday things of life. It is edited with the *you* of the reader, rather than the *I* of the editor, as its dominating idea. In this one issue, for example, are described scores of new machines, processes, and discoveries. Each of them tends to bring human beings a few steps nearer the common goal of happiness.

* * *

THE average man's biggest task is to rule himself. He must learn to control himself before he can learn to control the elements. So it is that articles such as that on Will Power, page 25, help him get the most out of life. This month Dr. James J. Walsh, practical scientist, analyzes the average man as a chemist might analyze water. He shows him how he can develop himself by utilizing hidden and often unsuspected resources and energies. He dwells on psychology—the new science of the mind—which yet is in its infancy.

* * *

THE average man has an average body. It may be likened to an automobile engine that must see him to the end of his journey. But any engine, to operate successfully, must have care. So **POPULAR SCIENCE MONTHLY** publishes articles such as those on Swimming, page 43, and Vacations, page 57. In them eminent authorities show

the average man how to protect his body; and how to operate it properly.

* * *

MOST men today have automobiles, or hope to have them. With car ownership come problems. So each month Harold F. Blanchard, able automotive engineer, reaches out through these pages in an effort to help solve those problems. He tells the average man how to know his car. On page 69 of this issue he has a noteworthy contribution on auto-camping. His article should save many motorists 40 per cent of the running expenses on the summer tour.

* * *

SIMILARLY, Jack Binns, famous for the last dozen years as a radio expert, has done much through this magazine to take radio from the laboratory into the home of the average man. In terms that are easily understood, he tells us of things, the knowledge of which hitherto has been confined to a little circle of technical experts. This month, page 39, he shows just how to silence shrieks and groans in sensitive radio sets.

* * *

THE average man has a home and family, or expects to have them. He wants to know how to make new and useful things for that home. He wants to know how to lighten the daily labor in his household. He wants to know how to use tools easily and quickly. Our Home Workshop and Better Shop Methods departments, pages 73 and 78, answer those wants. These departments are filled with practical hints for the man who knows the joy of doing things himself.

* * *

IN SCIENCE there is imagination. And so for the average man, the curious man, the imaginative man, **POPULAR SCIENCE MONTHLY** is like a magic carpet. Hundreds of articles and pictures in each issue can transport him to places where men are doing new and amazing things and thinking new and significant thoughts.

See Table of Contents on page 112

POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, \$2.50; foreign countries, \$3.

Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.

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The contents of this magazine must not be reprinted without permission.

H. J. Fisher, President; R. C. Wilson, Vice-President
O. B. Capen, Secretary and Treasurer

Making More Money Than The Boss

If you think it can't be done then there is a surprise in store for you.

THERE is one profession, and only one, in which the Boss often makes less money than some of the men under him. And you can—but read the letter below, received a short while ago by the National Salesmen's Training Association from a Sales Manager who was investigating this System of Training, with a view to increasing his own efficiency.

The record of this student is in the Association files, but it is no different than hundreds of other really amazing records of inexperienced men who have studied this wonderful system of Salesmanship Training

Why Salesmen Are Well Paid

How would you like the opportunity to make more money than the man who employs you? Sounds almost foolish, doesn't it? Many salesmen earn more money than the man or men above them. In some cases, they earn far more than the President of the Company.

There is a good reason why the same ability will command a larger income in the selling end of business than in other departments. The men in the shops making the goods, and the men in the office handling routine accounts and credits, can never be as vital to a business as the men out selling—their efforts actually determine how much goods shall be made.

Irving T. Bush, Founder and President of the Bush Terminal Company, in an article in the AMERICAN MAGAZINE, said:

"Go through any industry and you will find the same grade of intelligence is better paid in the selling force than it is in any other department. To those men who must make money to take care of responsibility and support of family, I again say, 'GO SELL.' And opportunities for selling jobs are ten to one in other fields."

Secrets That Make Master Salesmen

From greenhorn to star salesman in next to no time sounds almost too good to be true. Yet, the National Salesmen's Training Association performs this wonderful transformation for thousands year after year because it teaches the *real secrets of salesmanship*. For example:

EMPLOYERS are invited to write to the Employment Department of the N. S. T. A. We can put you in touch with just the men you need. No charge for this service to you or our members. Employers are also cordially invited to request details about the N. S. T. A. Group Plan of Instruction for entire sales forces. Synopsis and charts sent without obligation.

"I note in your literature the names of some of the boys from Kentucky and Indiana with whom I am well acquainted. One of the boys from Kentucky, by the way, broke in under me. While still a cub, and without my knowledge, he took up the N. S. T. A. Course and it wasn't long before I got a jolt. His weekly pay checks were even larger than my own."

"His increased earnings made me question him and it was then he admitted he was studying with you. The fact that he continued to succeed in such a big way caused me to write to you."

"I do not envy this man in the slightest degree, but I do want to say that if your training could develop this particular man into a high-class salesman, as it has, then your course could almost make a wooden Indian into a salesman."

"Had you met this man when I did you would have hesitated about accepting his enrollment. I am free to admit that he of all others has taken the conceit completely out of me when it comes to passing judgment on prospective Salesmanship timber."

Charles Berry of Winterset, Iowa, stepped from \$18 a week to a position making him \$1,000 the very first month.

J. P. Overstreet, Denison, Texas, was on the Capitol Police Force. He took up this study and very shortly after he earned \$1,800 in six weeks as a salesman. F. Wynn, Portland, Oregon, ex-service man, never thought he was cut out for selling, yet earned in one week \$554. George W. Kearns, of Oklahoma City, was making \$60 a month and then earned \$524 in two weeks as a salesman. Warren Hartle, Chicago, spent ten years in the railway mail service. Then jumped into selling and multiplied his earnings six times the first year.

Why did these men—farm hands, mechanics, bookkeepers, clerks, railroad men and routine workers in every walk of life—attain such quick success. The answer is as simple as A B C. There are certain ways of doing and saying things in selling—certain ways to approach different types of prospects to get their undivided

attention, to stimulate interest—certain ways to overcome objections, batter down prejudices, outwit competition, and make the prospect act. Once you know these vital things—once you have acquired these fundamental principles—big success awaits you in this fascinating field.

attention, to stimulate interest—certain ways to overcome objections, batter down prejudices, outwit competition, and make the prospect act. Once you know these vital things—once you have acquired these fundamental principles—big success awaits you in this fascinating field.



Previous Experience Unnecessary

It doesn't matter what you are now doing for a living. If you can read and have average intelligence there is a wonderful future awaiting you in the selling field. If you must make more money, if you want to attain a measure of financial independence, if you want to accomplish worth-while things, then let us send you all the facts about this remarkable System of Salesmanship Training and Employment Service, including a big, FREE, illustrated book, "Modern Salesmanship."

In this book you will find full details about the National Demonstration Method which gives you actual experience while studying, complete information about the N. S. T. A. System of Electives which enables you to go out and sell a line, fortified with proven plans and successful methods of Master Salesmen in the line or lines you choose to sell. Also tells how N. S. T. A. Free Employment Department helps you to select and secure a position as local or traveling salesman as soon as you are qualified and ready.

Send Now for Proof and Free Book

To mail the coupon below may prove to be the turning point in your career as it has for thousands. It will not obligate you, though it may inspire you to make a move in the direction of bigger pay, more opportunities, and congenial work. Don't hesitate. A good idea to get it into the mail right NOW.

National Salesmen's Training Association

Dept. 15-H, Chicago, Ill.

National Salesmen's Training Association
Dept. 15-H, Chicago, Ill.

Please mail me Free Proof that I can become a Master Salesman and qualify for a good sales position. Also send your illustrated book, "Modern Salesmanship," and particulars of Membership in your Association.

Name.....
Address.....
City..... State.....
Age..... Occupation.....

Money Making Opportunities for "Popular Science" Readers



AUTOMOBILES AND ACCESSORIES

PATENTS—Write for free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest reference. Reasonable terms. Victor J. Evans & Company, 189 Ninth, Washington, D. C.

AUTOMOBILE owners, garagemen, mechanics, send today for free copy of America's most popular motor magazine. Contains helpful articles on overhauling, repairing, ignition, carburetors, batteries, etc. Automobile Digest, 523 Butler Bldg., Cincinnati.

PRONTO series gap, spark plugs. Mica construction. Guaranteed life of Motor. Positively shoot through oil. 100% Government test. Real distributors and salesmen wanted. Pronto Spark Plug Co., Omaha, Nebraska.

\$100—Insayde Tyres inner armor for automobile tires. Prevent punctures and blowouts. Double tire mileage any tire. Tremendous demand. Big profits. Sample and details free. American Accessories Co., B 179, Cincinnati, Ohio.

AUTOMOBILE PARTS—Used parts for most any car at half factory list prices. Allen, Briscoe, Buick, Cadillac, Chalmers, Chevrolet, Dodge, Ford, Grant, Hudson, Hupmobile, Oakland, Overland, Oldsmobile, Reo, Studebaker, and many others. Send list of parts wanted. Maxwell Bros., 4106 Olive St., St. Louis, Missouri.

FORD ACCESSORIES

BRIGHT light and dimmer for magneto lighted Fords. Guarantee. Sample \$2.50. Sunlight, Box 394, Chicago, Ill.

SPEEDSTER fans—see "Red-I-Kut" ad page 100.

FORD owners, don't ruin your car by leaving it chatter. Correct same by installing Bredar's Ball Shim. Price \$1.10. Ask your dealer or write for information. Nic Bredar's Son Mfg. Co., Rock Island, Illinois.

WANTED

DETECTIVES—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, New York.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

DUPLICATING DEVICES

"MODERN" Duplicators save Time, Labor and Money. Gets Business. Reproduces Typewritten or Penned Letters, Drawings, Lessons, Music, Menus, Bids, Notices, Specifications, Maps or anything in one or more colors. Prints two per minute. Special sale on 30 Days' Free Trial. \$2.25 up. Booklet free. J. V. Durkin-Reeves Co., Pittsburgh, Pennsylvania.

STENCIL duplicator, two dollars. Prints typewriting, handwriting. On approval. Primos Specialty Co., Box Primos, Pennsylvania.

SIMPLE device. Duplicates letters, drawings, etc. Thousand copies hour. No putty or gelatine mashing. Inexpensive to make. Clean printing. Samples, particulars free. L. Knight Co., Brooklyn, Baltimore, Maryland.

MANUFACTURING

WE design and build special machinery. Send for free copy of Modelcraft. R. G. Clyne Engineering Co., St. Louis, Mo.

MODELS, developing ideas and manufacturing my specialty. Absolute satisfaction, low rate. Thirty-three years' experience. Write me first. H. Backer & Co., 904 Eym, Cincinnati, Ohio.

LABORATORY AND CHEMICAL

EXPERIMENTERS. Complete supplies for the chemical laboratory. Catalogue 5c. National Scientific Supply Co., 211 Pennsylvania Avenue, Washington, D. C.

YOUR chemical problem solved and working process furnished for five dollars. Write me. W. Stedman Richards, Consulting Chemist, Box 2402, Boston, Mass.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

TRADE SCHOOLS

EARN more money—Learn sign painting, scenic painting, showcard writing, auto painting, paper hanging, decorating, gilding, marbling, at Chicago or at your home. Chicago Painting School, 157 West Austin Avenue, Chicago.

LEARN Modern Barbering. It pays. Clean—carefree—short course. Can travel, see the world, or be your own boss. Will equip shop on payments. We have 33 branches. There is one near you. Write any address below for booklet D telling all. (You do not need street address.) Moler System of Colleges, New York City; Chicago, Ill.; St. Louis, Mo.; Kansas City, Mo.; Cincinnati, O.; Cleveland, O.; Detroit, Mich.; New Orleans, La.; Atlanta, Ga.; Memphis, Tenn.; Milwaukee, Wis.; Omaha, Nebr.; Denver, Colo.; Dallas, Fort Worth, San Antonio, Houston, Texas; or Toronto, Ont., Canada.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

LEARN photoengraving. Short intensive course. Positions secured. Terms reasonable. Catalogue address, Eaton School of Photoengraving, Ethingam, Illinois.

Another \$25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:—

What advertisement of "Money Making Opportunities" in this issue interests you most-and why?

Here are the prizes we will pay for the ten best letters answering the above question:—

First Prize \$10.00
Second Prize 5.00
Third Prize 3.00
And 7 Prizes
of \$1.00 each 7.00

First read every one of the "Money Making Opportunity" advertisements on pages 4 to 16. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, *not more than seventy words*, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before July 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the September Issue. Address your prize letter to—

Contest Editor

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City
Last Month's Prize Winners

The first prize of \$10.00 goes to Mr. E. J. Morrissey, 1107 East Second Street, Sterling, Ill., for his letter on the advertisement of the Ohio Smelting Company. Here is Mr. Morrissey's letter:—

Dear Sir:

The advertisement of the OHIO SMELTING COMPANY, OHIO, interests me most. I found a lot of "junk" around the house whose intrinsic value was not impaired and while packing it, I realized that our Company discarded old Platinum Regulator points and a systematic search rewarded me beyond expectations, and maybe—well I'm not counting my chickens but while I'm waiting I will again look over your "Money Making Opportunities."

Very truly yours,
E. J. MORRISSEY.

Mr. Erroll Moss, 809 East 19th Street, Uni. Place, Nebr., wins the Second Prize for the following letter regarding the Victor J. Evans advertisement:

Dear Sir:

The advertisement of Victor J. Evans & Co., Washington, D. C., interests me mostly for these reasons:

Plenty of space is used to tell just what is wanted and what is represented. It is consistently written, forceful and to the point.

It gives me a clear cut idea. It gains my interest long enough to make me think seriously.

It makes me believe that the company practices business integrity.

ERROLL MOSS.

The third prize goes to Edward Koos, Jr., 521 Broad Street, Kenosha, Wisconsin.

The winners of the other seven prizes are:

Emile W. Zingg, Seattle, Wash.; Frank G. Davis, Richmond, Va.; H. L. Jordan, Tulsa, Texas; Raymond Rowe, Elk Rapids, Mich.; Amy D. Putnam, Washington, D. C.; F. H. Hunter, Currituck, N. C.; Madeline Hutchinson, Marysville, Cal.

Rate 25 Cents a Word. Advertisements intended for the September issue should be received by July 5th

RADIO SUPPLIES

THE Perfect "Fishing" Record. Experienced radio operators have found a big advantage in keeping permanent records of their "catches." White & Wyckoff's Handy Radio Record is the ideal record form. It tells at a glance the code, location, ownership, wave length, date of every find. The sheets are perforated and can be taken from any part of the pad without disturbing the others. Get this Handy Radio Record and keep a convenient and systematic record of your radio results. 5 pads of 40 sheets each, size 6"x9" for \$1.00. Sent postpaid anywhere on receipt of price. Remit by check, cash or money order to White & Wyckoff Mfg. Co., makers of the famous Autocrat Stationery, 105 Water Street, Holyoke, Massachusetts.

RADIO Generators: 500 volt 100 watt, \$23.50; high speed motors—Federal Phones, \$5.50. Battery chargers, \$12.50. Motor Specialties Co., Crafton, Pittsburgh, Pennsylvania.

1500 MILE vacuum tube receiver \$29.50. Radio, 4415 Market, Philadelphia.

AVIATION

THE American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 1744, 3601 Michigan Ave., Chicago, Illinois.

PROPELLERS for aeroplane propulsion, 5-foot diameters, \$12; 6-foot for Fords, \$15; others in proportion. Motorcycle sleigh blueprints, 75c; Ford size, \$1.00. Pictures free. Crawford Motor and Aeroplane, Long Beach, Calif.

INVENTORS desiring information write for our free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for our opinion of its patentable nature. Highest references. Prompt service. Reasonable terms. Victor J. Evans & Company, 151 Ninth, Washington, D. C.

ADDING MACHINES

FREE trial, marvelous free adding machine. Adds, subtracts, multiplies, divides, automatically. Work equals \$350.00 machine. Price only \$15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write today for catalog and free trial offer. Lightning Calculator Co., Dept. O, Grand Rapids, Mich.

FORMULAS

3,500 FORMULAS, recipes, trade secrets, 424 pages, \$1.00. Hillside Laboratories, 7021D South Winchester, Chicago.

FORMULA catalog free. C. A. Lutz, Apartment 241, York, Pennsylvania.

FORMULAS of the better sort. Write for our free catalog. National Scientific Laboratories, 213 North Monroe, Richmond, Virginia.

MOTORCYCLES, BICYCLES, SUPPLIES

DON'T buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galenburgh, Kansas.

PARTS for all motorcycles cheap. Schuck Cycle Co., 1922 Westlake, Seattle, Washington.

NEW and Used Parts for all makes. Send for our prices. Kingshighway Cycle Co., 1166 North Kingshighway, St. Louis, Missouri.

DEALERS and riders: Attention: Write for our special Motor cycle saving bulletin. Dealer's bulletin No. 8 and riders' bulletin No. 42. Motorcycle Parts Mfg. Co., 2030 Wabash Ave., Chicago, Ill.

MOTORS, ENGINES, MACHINERY

MOTORS: G. E. $\frac{1}{4}$ H. P., \$16.50; $\frac{1}{2}$ H. P., \$29.50; 5 H. P., \$98.50. Generators: 8 volt 10 amp., \$15.00; 32 volt 500 watt, \$29.50. Write for Catalog. Motors Specialties Co., Crafton, Pittsburgh, Pennsylvania.

FOR BOYS

WONDER Fish Lure make fish bite like hungry wolves. Box 25c; five \$1.00. Hamilton, Barnes City, Iowa.

AMERICAN MADE TOYS

MANUFACTURERS on large scale, also homeworkers wanted to manufacture metal toys and novelties. Millions needed of barking dogs, wag tail pups, wild animals, automobiles, Indians, cowboys, baseball players, cannons, toy soldiers, crowing roosters, statues of Liberty, miniature castings of capital, bathing girl souvenirs and others. Unlimited possibilities. Guaranteed casting forms furnished manufacturers at cost price from \$5.00 up, with complete outfit. No experience or tools necessary. Thousands made complete per hour. We buy goods all year and pay high price for finished goods. Cash on delivery. Contract orders placed with manufacturers. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1696 Boston Road, New York.

FOR THE HOME

GRANDFATHER clock works, \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Pennsylvania.

Get a Job Like These Earn \$3500 to \$10,000 a Year



**20 Years Old—
Makes Almost
\$500 a Month**

Harold Hastings of Somers, Mass., says: "The profit on my electrical business amounts to \$475.00 a month. My success is due entirely to your instruction. You make your men just what you say—Electrical Experts. No man will ever make a mistake enrolling for your course."



**Dickerson Gets
\$7500 a Year**

"I earned \$30 a week when I started with you—\$50 a week when half through your course. Now I clean up at the rate of \$7500 a year. Thank you a thousand times for what you did for me. Electricity pays big on the farm." Herbert M. Dickerson, Warrenton, Va.



**\$20.00 a Day for
Schreck**

"Use my name as a reference and depend on me as a booster. The biggest thing I ever did was answer your advertisement. I am averaging better than \$500 a month from my own business now. I used to make \$18.00 a week." A. Schreck, Phoenix, Ariz.



**Pence Earns
\$9000 a Year**

W. E. Pence, Chelalis, Wash., says: "Your course put me where I am today. Mr. Cooke—making \$750 a month doing automobile electrical work—think of it—\$9000 a year. Besides that I am my own boss. My wife joins me in thanking you for what you did for us."



**\$30 to \$50 a Day
for J. R. Morgan**

"When I started on your course I was a carpenter's helper, earning around \$5.00 a day. Now I make from \$30 to \$50 a day and am busy all the time. Use this letter if you want to—I stand behind it." J. R. Morgan, Delaware, Ohio.



**Spare Time Work
Pays Stewart
\$100 a Month**

"Your course has already obtained a substantial increase in pay for me and made it possible for me to make at least \$100 a month in spare time work. You can show this at the weak fellows who haven't made up their minds to do something yet." Earl Stewart, Corona, Calif.

in the Big Pay Field of ELECTRICITY

It's your own fault if you don't earn more. Blame yourself if you stick to your small pay job when I have made it so easy for you to earn \$3500 to \$10,000 a year as an electrical expert. Electrical Experts are badly needed. Thousands of men must be trained at once. One billion dollars a year is being spent for electrical expansion and everything is ready but the men. Will you answer the call of this big pay field? Will you get ready now for the big job I will help you get? The biggest money of your life is waiting for you.

I Will Train You at Home

I will train you just like I trained the six men whose pictures you see here. Just like I have trained thousands of other men—ordinary, everyday sort of fellows—pulling them out of the depths of starvation wages into jobs that pay \$12.00 to \$30.00 a day. Electricity offers you more opportunities—bigger opportunities—than any other line and with my easily learned, spare time course, I can fit you for one of the biggest jobs in a few short months' time.

Quick and Easy to Learn

Don't let any doubt about your being able to do what these other men have done rob you of your just success. Pence and Morgan and these other fellows didn't have a thing on you when they started. You can easily duplicate their success. Age, lack of experience or lack of education makes no difference. Start just as you are and I will guarantee the result with a signed money back guarantee bond. If you are not 100% satisfied with my course it won't cost you a cent.

Free—Electrical Working Outfit and Tools

In addition to giving my students free employment service and free consultation service, I give them also a complete working outfit. This includes tools, measuring instruments, material and a real electric motor—the finest beginners' outfit ever gotten together. You do practical work right from the start. After the first few lessons it enables you to make extra money every week doing odd electrical jobs in your spare time. Some students make as high as \$25 to \$35 a week in spare time work while learning. This outfit is all FREE.

Mail Coupon for FREE BOOK— The Vital Facts of the Electrical Industry

The coupon below will bring you my big free electrical book—over 100 interesting pictures. The real dope about your opportunities in electricity—positive proof that you, too, can earn \$3500 to \$10,000 a year. Send for it now. Along with the book I will send you a sample lesson, a credit check allowing you a \$45.50 reduction, my guarantee bond and particulars of the most wonderful pay-raising course in the world. Send the coupon now—this very second may be the turning point in your life. Send it while the desire for a better job and more money is upon you, to

L. L. COOKE, Chief Engineer

Chicago Engineering Works

DEPT. 3-B 2150 Lawrence Ave., Chicago

The Cooke
Trained Man
is the Big
Pay Man



L. L. COOKE, Chief Engineer, Dept. 3-B
Chicago Engineering Works, Chicago, Ill.
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RADIO has jumped into the front rank of the world's great industries. In its colossal growth it has swept across the face of the earth. The shores of every continent are dotted with Radio stations. Nearly every vessel on the seven seas is a floating Radio station. Thousands of factories are busy day and night supplying the tremendous demand for equipment and apparatus. Every night millions of people "listen in" to Radio broadcast news, music, entertainment and education.

See the World as an Officer

Radio operators on swift ocean greyhounds are traveling the world over, visiting famous scenes, enjoying a wonderful life of romance and adventure—and at the same time getting a splendid salary. At land and broadcasting stations, operators, aids, specialists are doing this new and interesting work—and making big money doing it. Under their fingers flows the story of the world's progress. To them comes news from far-off countries speeding through the skies. Factories, stores, laboratories, banks, cities, business houses, newspapers and schools are employing Certified Radio-tricians as operators, maintenance,

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Now the Fastest Growing Business

Yet Radio is only in its infancy. Despite the marvelous advances of the last few years we are only on the threshold of the Radio era. We have barely scratched the surface of its vast possibilities. We have merely guessed its yet undiscovered wonders! Great as Radio is today it will be a thousand times greater tomorrow! The man who gets into Radio today—who prepares NOW to grow up with this wonderful new science—will have a great share in its glorious future. He will be able to win fame, honor and wealth in this fascinating profession.

How You Can Qualify at Home for a Fine Radio Position

For the ambitious man, Radio offers greater opportunities for success than any other profession or trade. No matter what your condition, no matter what your education or your ability, there is a special field in Radio where your natural talents will bring you a wonderful position, doing easy, interesting work at a fine salary; where your success is almost certain.

The National Radio Institute, known the world over as the oldest and largest Radio Training Organization, will prepare you quickly in your spare time at home to qualify for the position you want. Hundreds of our graduates are today reaping big returns from their instruction. Some of them are radio inspectors and engineers. Others are in charge of land and sea stations. Still others are in charge of radio departments in stores or are in business for themselves. But no matter in what special field they have gone, all of them are earning more money than they ever made before.

Big Money—Easy Work

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In the panel on the left are just a few of the positions open to the Certified Radio-trician. Thousands of splendid big-paying positions are going begging for want of men able to handle them. Get into Radio Now. Grow up with it. Advance with it.



PICK OUT THE JOB YOU WANT WE WILL HELP YOU GET IT

This is a brief list of the positions in the Radio field today, and the salaries paid:

- Radio Mechanic, \$1,500 to \$4,000 a year.
- Radio Inspector, \$1,800 to \$4,500 a year.
- Radio Salesman, \$2,000 to \$10,000 a year.
- Radio Engineer, \$3,500 a year and up.
- Radio Executives, up to \$15,000 a year.
- Radio Instructor, \$200 to \$500 a month.
- Radio Draftsman, \$7 to \$15 a day.
- First Class Ship Operator, \$105 a month, all expenses paid.
- Second Class Ship Operator, \$95 a month, all expenses paid.
- Third Class Operator, \$85 a month, all expenses paid.
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Special Opportunity Now Open

The urgent need for radio experts and the calls which come to us for our students prompt us to make a special offer open to new students for a limited time. Through this special offer your enrollment will be accepted at a special rate, and you will receive, without extra cost, our new course in Wireless Telephony.

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We have just prepared a new book which is filled with the latest information about the wonderful opportunities in this newest and fastest growing profession. It will be sent to you absolutely without cost. Send for this book. It will tell you all about how we prepare you for, and help you to get or secure the wonderful positions open in this fascinating field. Mail coupon for this book NOW!

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Send me your free book, "Your Opportunity in Radio" with full particulars about the opportunities in Radio, and how you will quickly train me in my spare time at home to become a Certified Radio-trician. Also tell me how your free Employment Service will help me to a position and particulars of your special short-time offer.

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BUY your cigars direct. 50 Aromor prepaid, \$1.50. Money back if dissatisfied. Agents wanted. Havana Smoke-house, Homeland, Ga.

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Steady work. No layoffs. Paid vacations

Common education sufficient.

Travel—See the Country.

COUPON

Millions Suffer Foot Tortures

-because of One Tiny Misplaced Bone

FOOT specialists have just perfected a marvelous new invention—an invention which is instantly relieving thousands of people of their foot pains—and which gives one the glorious feeling that he is actually *walking on layers of air!*

No longer need you suffer those terrible foot pains that leave you exhausted!

No longer need you tolerate the aches and burning that make life miserable!

Nor need you suffer those agonizing twinges in the arches and instep that make walking a torture. For scientists have found the

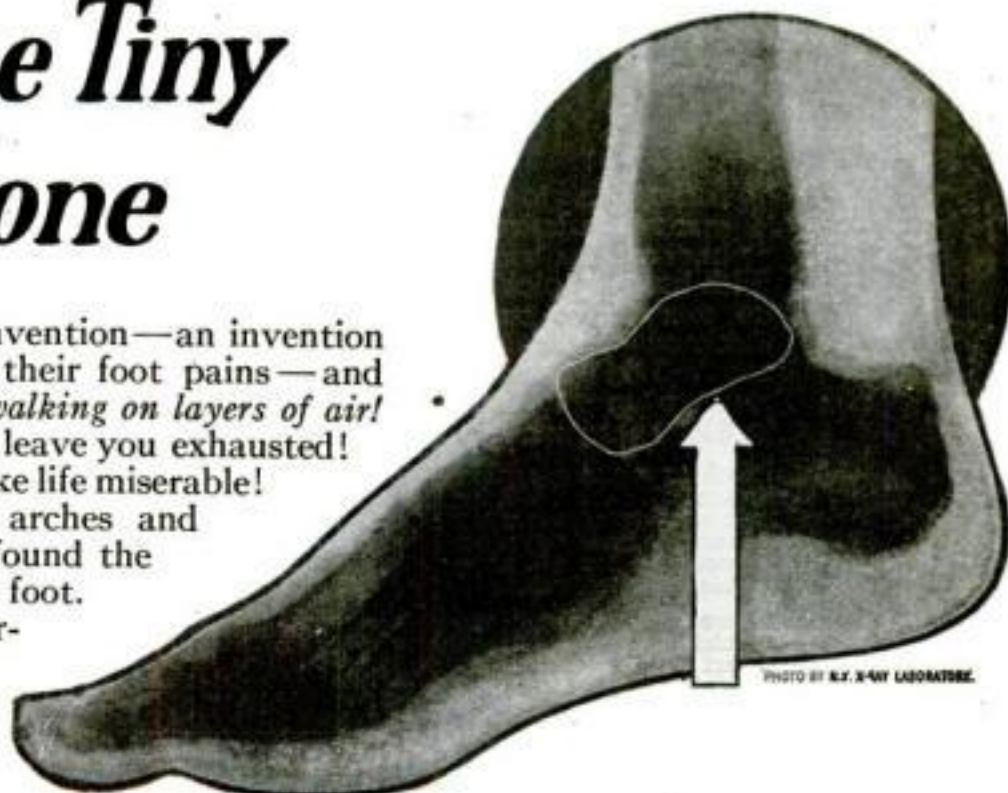
real *cause* of most troubles—a tiny misplaced bone in the foot.

Even the slightest displacement of this bone means ter-

rrible pain. But with this new invention you can gently

work this bone *back* into place, with the result that

every pain disappears—*instantly*—as if by a touch of a magic wand!



How Startling New Discovery Corrects the Trouble and Relieves Foot Pains Instantly!

MILLIONS of people have the mistaken idea that their sore, burning, aching feet are due only to the pinching of their shoes. Other pains in the legs and thighs are wrongly attributed to rheumatism.

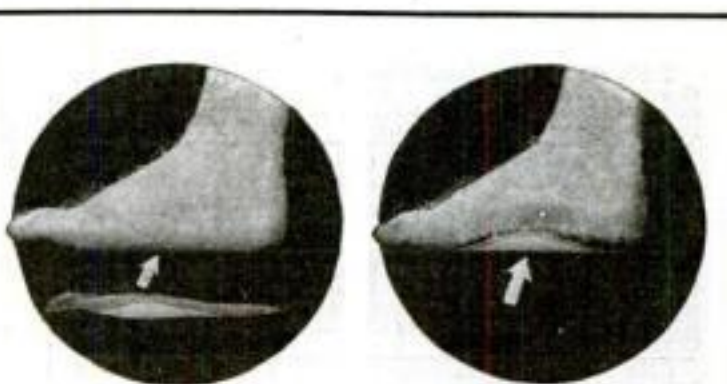
But Science now proves that 99 of every 100 foot pains are caused by a displacement of the **astragalus** bone—a small bone at the top of the foot arches. This bone supports your whole weight. It is held in place by a series of tendons and ligaments. But very often these tendons become weakened. This tiny bone, under the weight of the body, is then forced out of place. The result is fallen arches.

The arches are really the "wagon springs" of your body. They "give" every time your weight falls on the foot, thus absorbing the shocks of walking. But when the astragalus bone gets displaced, the arches instantly lose their springlike resiliency. As a result, when you walk, the whole weight of your body falls solidly on the delicate bones and muscles of your feet, causing all sorts of foot misery. Just as an automobile without springs would soon break down, so it is with your feet. The muscles become twisted out of place, sensitive bones are placed under terribly unnatural strains and delicate nerves are tortured.

How New Invention Works

The old way of treating fallen arches made no attempt to bring permanent cure. The arches were merely forced into position by using hard, unyielding braces or props. These were merely "crutches," for when removed, the arch flattened out again. Then, being rigid, they did not absorb the shocks of walking. It was just as if you placed a huge rock between the springs of a wagon. Their worst fault, however, was that instead of **strengthening** the foot muscles that support the arches, these rigid props actually weakened them because they did not exercise the muscles.

But how different is this marvelous new invention! It is made of Russian Sponge Rubber, and is in the form of a wonderfully light and springy pad, scientifically formed to the natural arch. It can be slipped into any



Note the Instantaneous Results!

The marvelous new Russian Sponge Rubber Arch Supports, which slip into your shoes, are entirely different from anything known or used before. There are no rigid appliances; no special shoes; no braces; no straps; no salves; no powders; no trouble or inconvenience of any kind. Yet the flattened arch is lifted gently back into place, pain is instantly banished—aching bones and muscles are instantly soothed—all swellings and soreness disappear immediately. And every step you take *strengthens and builds up* the torn and twisted ligaments until the foot becomes normal once more! Further use of the supports is then unnecessary.



styled shoe, yet were it not for the wonderful comfort and buoyancy that it brings, you would never be aware of its presence.

With a gentle even pressure at all points this resilient rubber at once raises the fallen arch to its natural position, gently working the displaced astragalus bone back into place. This instantly releases the pressure on the sensitive nerves and blood vessels, and takes all strain off the weakened muscles.

Bring Permanent Relief

At the same time, as this light and springy rubber yields to your weight, it reproduces exactly the **natural spring of your arch!** Its constant compression and expansion with every step massages, exercises and strengthens the muscles in a natural way—thus quickly bringing back their old-time vigor and strength.

The beauty of it all is that results are evident **instantly!** The moment you put on these wonderful supports all pain vanishes and walking becomes an actual pleasure.

Even if you are not troubled with your feet, you will find the Russian Sponge Rubber Arch Supports of tremendous value. Thousands of housewives, clerks, salesmen and others find that with these supports they can stand or walk all day long without the least bit of fatigue.

Send No Money

Many people have paid specialists as high as \$200 for the benefits that you can now secure from the Russian Sponge Arch Supports for an astonishingly small fraction of this amount.

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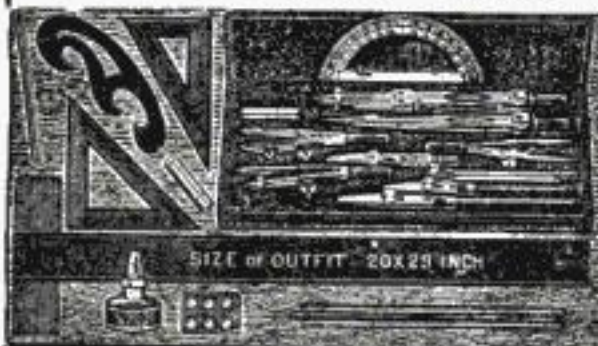
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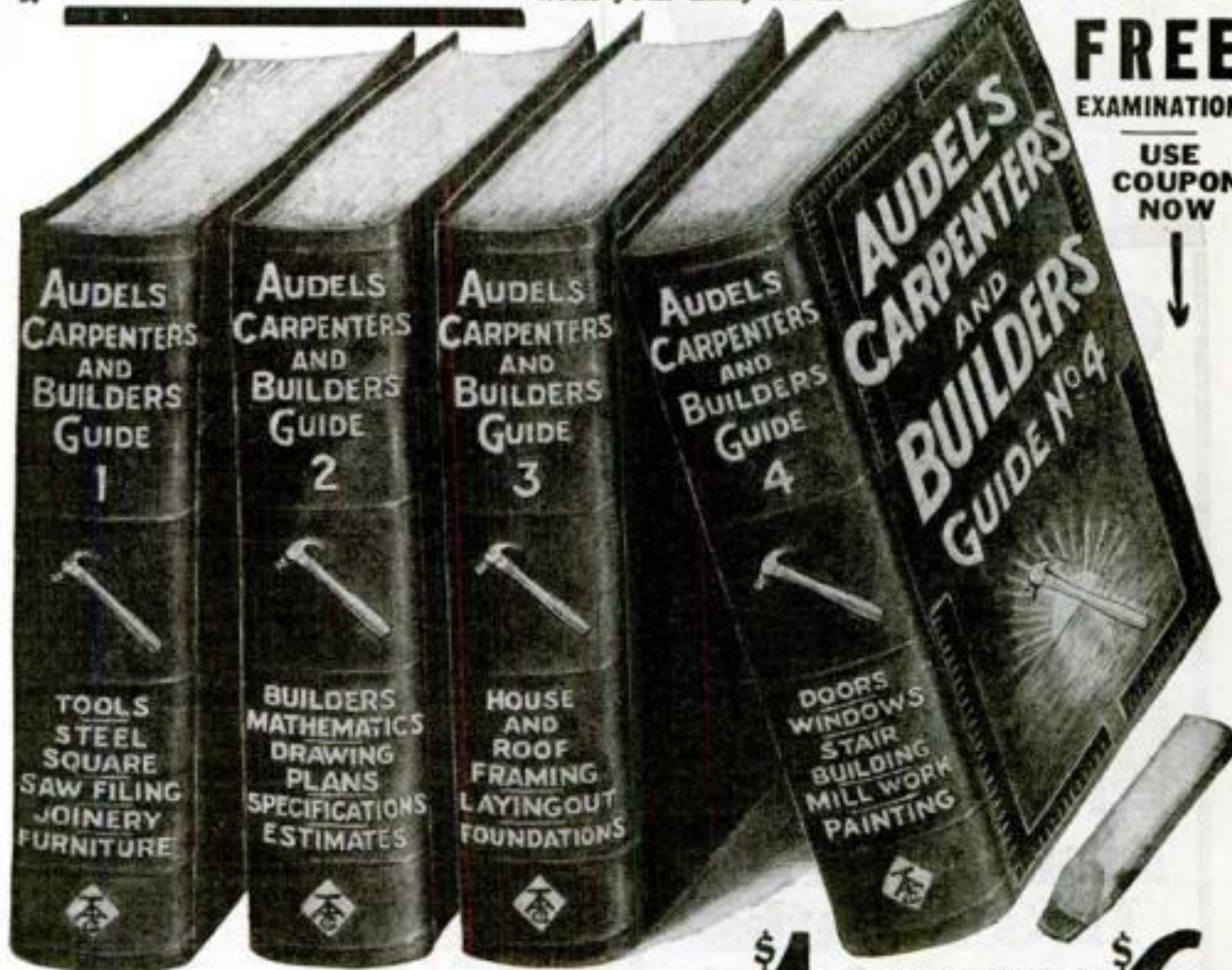
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MONEY manufacturing these biggest selling specialties in your own home, office, shop from Miller's Guaranteed Manufacturer's Formulas for all lines. Investment small. No machinery required. Stamp brings by return mail detailed information relative to manufacturing delicious Summer Drinks, Pure Food Products—full line, Laundry, Washing Marvel, Non-Thermic Ice Saving Cloth, Zebest Stain Remover, 30-Minute Beauty Clay, Hair-Silk, Marceline Curling Liquid, Amazon Rubber Repair, Toy Rubber Balloons and many other profitable money-makers. Don't confound these high class processes with the "junk" offered by others. I have been 26 years supplying the Best. Miller, Industrial Chemist, Tampa, Florida.

AGENTS make 500% profit handling auto monograms, new pictures, window letters, transfer flags, novelty signs. Catalog free. Hinton Co., Dept. 125, Star City, Indiana.

AGENTS—N w discovery makes all jelly "jell." Big profits, constant repeater. Sample free. Joy-Jel Company, 804 Grand, St. Joseph, Missouri.

WANTED—District Purchasing Agents. Experience unnecessary. National Instrument Co., 4707 North Hamilton, Chicago.

PREMIER Premium Plan Free. Have others sell. Perfected Self-Threading Needles, Sachet, Inklets. Profitable, permanent business your own. Patten Products, Box 372-X, Washington, District of Columbia.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising Popular Science Monthly, 225 West 39th Street, New York.

POLMET polishing cloth cleans all metals; sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

AGENTS: Big money selling great household necessities. Sample quarter. Webster Co., 2545 N. Clark St., Chicago.

WE start you without a dollar. Soaps, extracts, perfumes, toilet goods. Experience unnecessary. Carnation Co., Dept. 21, St. Louis.

AGENTS—Clever Invention! Inkspoon makes every pen a fountain pen. Fast office seller; big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Building, New York.

EARN \$2.00 an hour in your spare time taking subscriptions for this magazine. Write to-day for the agency in your town. Popular Science Monthly, 225 West 39th Street, New York.

EVERYBODY uses extracts. Sell Duo Double Strength Extracts. Complete line household necessities. Big repeaters. Write today. Duo Co., Dept. E66, Attica, N. Y.

SALESMEN can make \$5.00 a day selling our calendars, pencils, signs, advertising novelties, yardsticks, whistles, etc. Liberal terms. Sells entire year. Fine side line. Local and traveling agencies. Model Calendar Co., Dept. 309, South Bend, Indiana.

MAKE money silvering mirrors, all kinds plating, knives, spoons, auto headlights. Outfits furnished. Free booklet. International Laboratories, Dept. 27, 311 Fifth Avenue, New York.

(1) RUB Metal Polish Chamol Cloth. Retail (30c)—Costs (10c). Cleans, Polishes, Silverware, Brass, all Metals. NuLife (B) Metal, Hartford, Conn.

AGENTS to sell high grade men's neckwear direct from manufacturer to consumer. Big profits, quick sales, free samples. S. Jackel, 2831 Third Ave., New York.

INSTANT Rubber Weld—Repairs largest punctures without cement or heat. Lenn's profit one day \$56. Write quick. Free sample. Territory going fast. Tourist's Pride Mfr. Co., Desk R, Minneapolis, Minnesota.

SPECIALTY Salesmen of the highest type to sell Butterfly Tints, a non-boiling dye, to retail stores everywhere on liberal commission basis. Butterfly Tinting Company, Minneapolis, Minn.

AGENTS—\$20 daily easy distributing bamboo self-filling fountain pen; just out; sample free. Address Spors Co., LeSuer Center, Minnesota.

FASTEST selling advertising specialties. Liberal commissions. Mats Novelties, Reading, Pennsylvania.

AGENTS—If you have formerly sold felt rugs write for our new proposition concerning new goods. It's a winner. Newark Felt Rug Company, 56-L Bergen St., Newark, N. J.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

SELL wall and auto emblems, and town plates. Every lodge member and auto owner buys. Big money—all or spare time. Free sample and cash bonus plan. Kier Emblem Co., 442 Como Bldg, Chicago.

RAKE in the Coin—Get it all! Year round seller—no slack season. An average man made \$932.40 in the hot August of 1922. Spend six hours each day in actual selling and you may do better!

Slide into your opportunity with the Alexander line, while there is territory left. A fascinating work—selling motion-picture advertising—the fastest growing industry today. Immense future with harmonious associations. Your postal, will connect us. Alexander Film Company, 3385 Broadway, Denver.

ACCESSORY replacement-part. Most men sell 90% of calls, some earning \$100 weekly. Every auto owner and dealer interested. Bolla Mfg. Co., Bentown, Pennsylvania.

OWN A BUSINESS. Make sparkling glass name plates, numbers, check-boards, medallions, signs. Quick sales, big profits. Illustrated booklet free. E. Palmer, 557 Wooster, Ohio.

MAKE \$31.00 Profit—cost you \$1.50. Complete gold monogramming outfit. Transferred instantly on automobiles, trunks, bags, windows. Experience unnecessary. "Free samples." NuLife (B) Monogram, Hartford, Conn.

AGENTS—Men or Women, a Real honest-to-goodness sells itself line, over 250 lightweight, popular priced necessities. We pay 100 per cent commission. \$8.00 a day can be made at the start. No capital, no experience required. Enormous demand, sells fast, big repeaters. Valuable territory opened, all or spare time. Elegant agent's outfit furnished free. Write today, postal will do. Albert Mills, Gen. Mgr., 9603 American Building, Cincinnati, Ohio.

Why haven't
you clipped
this coupon?

IT takes but a moment to mark the career of your choice, sign your name, clip out and mail. Yet that simple act has started more than two million men and women toward success.

In city, town and country all over the world, men are living contented lives in happy prosperous homes—because they clipped this coupon.

In every line of business and industry, in shops, stores, offices, factories, in mines and on railroads, men are holding important positions and receiving splendid salaries—because they clipped this coupon.

Clerks have become sales, advertising and business managers, mechanics have become foremen, superintendents and engineers, carpenters have become architects and contractors, men and boys have risen from nothing to places of responsibility—because they clipped this coupon.

You have seen it in almost every magazine you have looked at for years. And while you have been passing it by, more than ten thousand men and women each month have been making it the first stepping stone to real success in life.

Will you still turn away from opportunity? Can you still go on, putting in your days at the same grind, getting the same pay envelope with the same insufficient sum, when such a little thing can be the means of changing your whole life?

You can have the position you want in the work you like best, a salary that will give you and your family the home, the comforts, the little luxuries you would like them to have. No matter what your age, your occupation, your education, or your means—you can do it.

All we ask is the chance to prove it. That's fair, isn't it? Then mark and mail this coupon. There's no obligation and not a penny of cost. It's a little thing that takes but a moment, but it's the most important thing you can do today. Do it now!

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Box 7645-C, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject before which I have marked an X:

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| <input type="checkbox"/> Business Law | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Banking and Banking Law | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Accountancy (including C.P.A.) | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Nicholson Cost Accounting | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Common School Subjects |
| <input type="checkbox"/> Private Secretary | <input type="checkbox"/> High School Subjects |
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| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Blue Print Reading |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Contractor and Builder |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Architectural Draftsman |
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| <input type="checkbox"/> Railroad Positions | <input type="checkbox"/> Structural Engineer |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Chemistry <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Automobile Work |
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| <input type="checkbox"/> Metallurgy <input type="checkbox"/> Mining | <input type="checkbox"/> Agriculture and Poultry |
| <input type="checkbox"/> Steam Engineering <input type="checkbox"/> Radio | <input type="checkbox"/> Mathematics |

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Street.....
Address..... 3-27-23

City..... State.....

Occupation.....
Persons residing in Canada should send this coupon to the
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CLERKS
TRAVEL—SEE THE COUNTRY
STEADY WORK—NO LAYOFFS—PAID VACATIONS
Common Education Sufficient
Influence Unnecessary

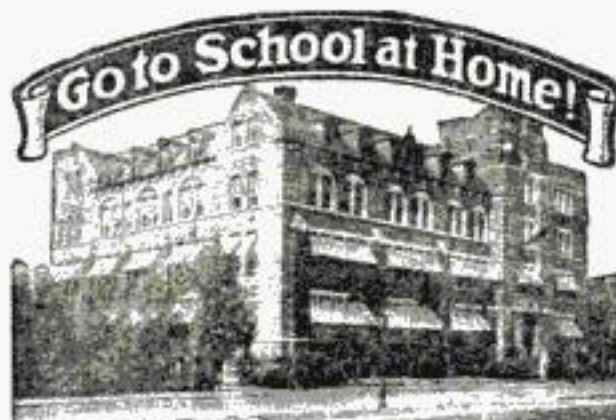
\$1600 to \$2300 Year
MEN—BOYS 18 TO 35.
MAIL COUPON
IMMEDIATELY

Franklin Institute, Dept. T-286, Rochester, N. Y.

Sirs: Send me without charge (1) Specimen Railway Postal Clerk Examination questions; (2) Tell me how I can get a U. S. Government job; (3) Send sample coaching lessons and list of Government jobs obtainable.

Name.....

Address.....



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training.

You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE

This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and meets all requirements of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people idle away fifty hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within two years. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

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Send me full information on the subject checked and how you will help me win success.

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|Structural Engineer |Employment Manager |
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|Cert. Public Accountant |Foremanship |
|Accountant and Auditor |Sanitary Engineer |
|Bookkeeper |Surveyor (& Mapping) |
|Draftsman and Designer |Telephone Engineer |
|Electrical Engineer |Telegraph Engineer |
|Electric Light & Power |High School Graduate |
|General Education |Fire Insurance Expert |
|Vocational Guidance |Wireless Radio |
|Business Law |Undecided |

Name.....

Address.....

Money Making Opportunities

AGENTS AND SALESMEN WANTED

AGENTS—Household necessities galore: food products, toilet preparations, extracts, remedies, soaps, beverages, jewelry, catalogs free. Western Proulx, 606 N. Oakley, Dept. AF, Chicago.

FREE SAMPLE. "Rain Shield Wiper." Retail \$1.00—Costs (25c). Sold, clear and rainy days. No cloth—no paste—no attachment. (1) Rub keep windshield clear (48) hours. Experience unnecessary. Nulife (1) Corporation, Hartford, Conn.

AGENTS—Free sample Dr. Elliott's Vegetable Oil Soap. 19 full sized packages right out of stock. Tea, coffee, extracts, spices, food products, laundry and toilet soap samples. Everything furnished. Send postal today. Department A-110, Harley Company, Dayton, Ohio.

WHY not sell us your spare time? \$1.00 per hour. \$9.85 Daily essay for full time—intro. using New Style Guaranteed Hosiery—57 styles, 17 colors—No capital or experience required. Just write orders. We deliver and collect. Your pay daily, also monthly bonus. Free auto offer besides. Complete outfit furnished. All colors—grades including silks. Mac-O-Chee Mills Co., Desk 1627, Cincinnati, Ohio.

SALESMEN, we pay larger commissions than any other Brush House in the country to men selling our line of Sanitary twisted in wire brushes Sanitary Wire Grip Brush, Co., 15-17 Mercer St., New York.

SELL "Rugdown" snap fasteners, keeps rugs in place prevents slipping. Dealers quickly interested. Vest pocket sample. Other quick-selling specialties. State experience, references. Empire Notion Company, 72 Madison Ave., New York.

100% profit each 50c sale. Staple tool indispensable to drivers. Sell to owners and chauffeurs. Profitable territory for workers. Can easily earn \$50 weekly. Perkins, 113 Leonard Street, New York.

80 Can You! Cota sold 300 one city. Beadle nine-town nine stores. Merchants need "Zim's Peerless" (Collection System). Retail \$7.50. Creditors' Association, D-312 McKnight Bldg., Minneapolis, Minnesota.

MAKE \$10.00 daily, taking orders for \$3.95 Union made raincoats. Factory prices. Largest commission. Your pay daily. We deliver and collect. American Eagle Raincoat Co., 185 No. Union St., Dept. 317, Chicago.

OUR new four point art embroidery needles at \$1.00 and rug needles at \$1.50 are wonderful sellers, every lady interested. Big profits. Particulars free. Ingersoll Bros., Box 9788, Houston, Texas.

EARN Big Money Fast applying gold initials to Autos. Every owner buys—\$1.35 profit on \$1.50 sale—particulars and samples free. Write quick. Lithogram Co., Dept. 30, East Orange, N. J.

SOMETHING NEW! A winning proposition for every ambitious person. 300% profit guaranteed. No canvassing; sample article—details 25c. Jamorris 2305 Grata, Phila., Pa.

FIFTY "Ideal" sidelines for mail dealers and salesmen 500% profit. N. Home, 1957 Warren, Chicago.

AGENTS—15 a day—Easy, quick sales—Free auto—Big weekly bonus—\$1.50 premium free to every customer. Simply show our beautiful 7-piece, solid aluminum handle cutlery set. Appeals instantly. We deliver and collect. Pay daily. New Era Mfg. Co., 803 Madison Street, Dept. 41-M, Chicago.

EASY, pleasant work for mechanics, shop men, clerks during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Novelty Cutlery Company, 27 Bar Street, Canton, Ohio.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

AUTO OWNERS! Get your tires free. Be our Factory Agent. Big spare time money-maker. Sample tires furnished. No capital or experience needed. Write today. Armour Tire & Rubber Co., Desk 103B, Dayton, Ohio.

\$100 TO \$300 a week. Men with slight knowledge of motors who can reach car owners can earn \$300 weekly without making a single sale. If they can also make sales, profits may reach \$25,000 yearly. Only proposition of its kind ever offered. A. H. Phillips, 228 West 29th Street, New York.

AGENTS: Sell biggest sensation. New; different; large profits. 12,000,000 prospects. \$12 daily easy. Free sample to workers. Higgins, Manager, Desk 726, McClurg Bldg., Chicago.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

CONSULTING ENGINEERS

STEEL Problems Solved. Practical. E. W. Rettew, Consulting Metallurgist, Wyomissing, Pennsylvania.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

INSECTS WANTED

WHY not spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth \$1 to \$7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10c (not stamps) for my Illustrated Prospectus before sending butterflies. Mr. Sinclair, Dealer in Insects, Dept. 7, Ocean Park, California.



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Learn at Home by wonderful print-and-picture method that teaches in half usual time. Far superior to private teachers. Simple as A, B, C—a child can master it. Your lessons consist of real selections instead of tiresome exercises. When you finish one of these delightfully easy lessons you've added a new "piece" to your list. You read real notes too—no "numbers" or trick music. Method is so thorough that many of our 300,000 students are band and orchestra LEADERS.

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phone, Ukulele,
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Note—To Art and Engraving Firms: Secure practical artists among our graduates. Write us.

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The Inspiring Story of how one poorly paid garage mechanic won success, his own business and a big income. Tells how you can increase your salary from 100 to 500%. Send for it today FREE.

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I can make a good penman of you at home during spare time. Write for my FREE BOOK, "HOW TO BECOME A GOOD PENMAN." It contains specimens and tells how others mastered penmanship by the Tamblin System. Your name will be elegantly written on a card if you enclose stamp to pay postage. FREE BOOK—Write for it today.

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Money Making Opportunities

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PROSPEROUS Realty business of your own or position worth \$3,500? Our graduates have choice. Training at home prepares you in short time. We help you make good. Bulletin free. Penn Realty School, 19th & Elsworth, Philadelphia.

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INCH Display Advertisement 161 Magazines Thrice \$15. Year \$50. Wood's Popular Services, Atlantic City.

PHILADELPHIA mail address and representation, \$5.00 monthly. Write, Shumway, 2816 North 28th.

BUSINESS men! Try our multigraphing, addressing and mailing service. We can save you money, satisfaction guaranteed. Write for our prices. M. S. Jones, Box "B," Alledo, Texas.

MAKE money with your camera. E. Lancaster, Box 967, Los Angeles.

PATENTS procured. Trade marks registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Building, Washington, D. C., or 2276-Z Woolworth Bldg., New York.

YOUR opportunity. Make big money at home in full or spare time. Be your own boss. How to make paste for storage batteries plates, 2 best dental creams, glass cement, 5 different colors of luminous paints. How to brighten Weisbach mantles, all complete for \$3.00. Worth \$100.00. Geo. F. Kinzel, 23 Washington St., West Orange, N. J.

ESTABLISH a cash business—no canvassing. Capital \$100 up. Information, Dept. R, Paul Kaye, 149 B'way, N.Y.

MAKE money. Let me tell you how. Details for stamp. Crane Mfg. Co., Box 16, Washington, D. C.

FREE book. Start little mail order business. Home employment evenings. Pier, 248-A, 74 Cortland St., New York.

OPERATE a typewriter exchange. Wonderful opportunities. My complete set instructions tells how. Write for full particulars. Sabin K. Elder, "The Typewriter Man," Box 8114, Brownsville, Texas.

WE pay \$1 to \$50 for publishable ideas regarding uses for old razor blades. Also royalties if idea has manufacturing possibilities. Write for details. The Astan Co., 315 Wesley Bldg., Columbus, Ohio.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

"CORPORATIONS organized and financed; patents bought and sold." Blanchet & Company, 347 Fifth Avenue, New York.

CAPABLE men wanted to open branch office and manage salesmen. \$300 to \$1000 necessary; handle your own money. Possibilities unlimited. Address Manager, 603 N. Eutaw St., Baltimore, Md.

LEARN swing trading and quick turns. Amazing new book shows you how. Write for circular of the Master Market Forecaster today. Market Forecaster Co., Dept. 14, Topeka, Kansas.

OUTDOOR life and a chance for wealth; Buy a Silver Lead mine in the Canadian Rockies. Lead and Silver in big demand. Several properties, \$2000 up. S. Gabel, Kaslo, B. C.

DEPENDABLE Solution For Raising Capital Quickly, economically, successfully. Outline proposition fully for valuable 30-page free book, "THERE IS A WAY." Robert S. Hansel, Financing Specialist, Dept. 401, 413 Fourth Avenue, Pittsburgh.

EARN \$2.00 an hour in your spare time taking subscriptions for this magazine. Write today for the agency in your town. Popular Science Monthly, 225 West 39th Street, New York.

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YOU can have a business profession of your own and earn big money in service fees. A New system of foot correction; readily learned by anyone at home in a few weeks. Easy terms for training, openings everywhere with all the trade you can attend to. No capital required or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 15 Back Bay, Boston, Massachusetts.

USED correspondence courses sold, rented, and exchanged. List free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

EXPERT chemist will furnish Formula and Trade Secrets in all lines. Lists free. W. L. Cummings, Ph. D., Gordon Avenue, Syracuse, New York.

WE start in business, furnishing everything. Men and women, \$30.00 to \$100.00 weekly, operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime. Booklet free. H. Ragdale Company, East Orange, New Jersey.

SELL by mail. Big profit opportunities free. Harvey Teeple, Decatur, Indiana.

GET into the specialty manufacturing business. Amazing profits. We will send you free book explaining our system. Write immediately. A wonderful opportunity awaits you. National Scientific Laboratories, 213 North Monroe, Richmond, Virginia.

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S. V. Smith, E. T., Chief Engineer, H. S. Dept., the S. & H. Electrical Works, 1422 W. Monroe St., Chicago, Ill., makes you an offer that no man who wishes to become a highly paid Electrical Technician can afford to miss. He offers you, on simple terms, an Electrical Review Course of Training in the S. & H. Electrical Shops with your railroad fare to Chicago from practically any point in the United States or Canada, paid in full. Just think of it; by the terms of this offer

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You have always longed for a chance to visit this great electrical center and wonder city of the West—Chicago, and, **Now**, here is your opportunity to do so—fare paid in full, with a splendid **Practical** Electrical Review Course thrown in. This review course will be given to you under the supervision of practical electrical engineers of great experience, and will cover:

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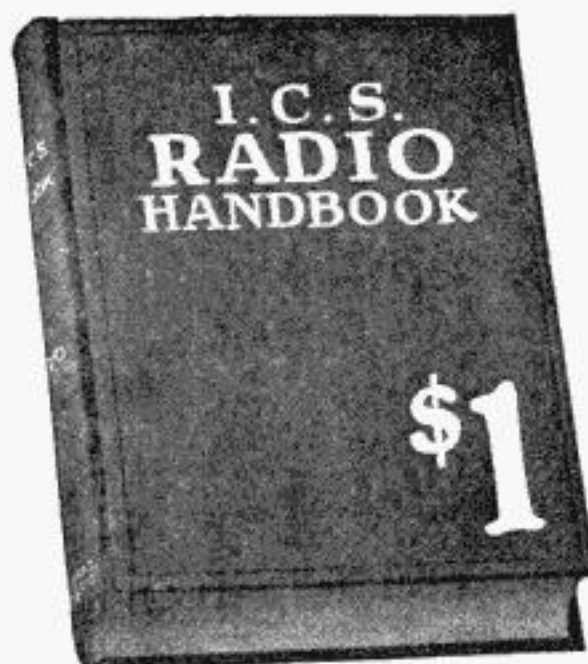
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32x4	10.30	17.35
33x4	11.90	18.30
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See page 4 in front of book for full details

How invention is now being taught as a science

How fifteen famous inventors heeded Edison's advice that "invention should be taught as a science" and are now showing hundreds how to develop their latent inventive ability through a fascinating new, easy home study course



Raymond F. Yates, who with fourteen other famous inventors, now makes it easy for you to learn how to invent in your spare time at home.

FOR a long time it was commonly believed that every invention was a matter of pure luck—the result of some happy inspiration that suddenly flashed through a man's brain, and which made him fabulously rich without the slightest effort or thought. But you can prove for yourself that this is not so. You can prove for yourself that invention is the result of thinking and action along definitely exact, scientific lines.

Suppose when you went home tonight, you found a window rattling. Through your mind would flash, almost instinctively, a regular order of thoughts which characterize the conception and completion of every invention the world has ever known. First, you would recognize a problem to be solved—the rattling of the window. Then you would think of several principles of science or mechanics which would solve your problem. You might think of the scientific fact that if you poured water on the frame the wood would swell and tighten the window. You might think of using a nail. But what you most probably would do, would be to use the oldest mechanical principle known to man, the wedge.

What Invention Is

Brought down to its simplest terms that is exactly the way every invention has been made—combining two ideas; a problem which must be solved and a fact of mechanics or science which solves the problem. So, although you may never have thought of it in just this way every time you solve a problem in your daily life—at home, traveling, or in business—you are an inventor; you use the principles of thought and action which govern the Science of Invention!

You can see, therefore, how easy it is for you to develop your natural instinct to "fix things." The same processes of thought that almost instinctively told you to fix a rattling window with a wedge can be so well developed that you can learn to invent other things almost as easily and quickly. You know, too, that every invention is made only by thinking inventively. And every inventor is agreed that the principles of Inventive Science are so simple, so easy to learn that any one, regardless of training or education, can develop himself to become a successful inventor!

How It Is Being Taught

But, although the fact has been universally recognized, that Invention is governed by a few simple,

easily acquired, fundamental principles, no one ever thought of putting these principles in black and white so that everybody interested in invention could read them. In spite of the fact that Thomas A. Edison made his famous statement that invention should be taught, as a science, thousands of people continued to work blindly, doggedly, haphazardly to perfect their ideas.

But now you can learn how to invent. Fifteen famous inventors have at last given to the world the laws and principles of Inventive Science. They have shown every ambitious man and woman how to invent. They are teaching Invention, exactly as other people are teaching law, medicine, book-keeping. Instead of spending years groping blindly, instead of wasting your time in useless, heartbreaking drudgery, you learn how to complete your ideas quickly; you learn how to think so you are sure to succeed.

A Fortune for One Little Idea

With every new advance, with every new discovery that the world experiences, more problems are coming up—and more inventions are needed to solve these problems. Now, as never before are new inventions wanted, and the world will pay a fortune to the man or woman who gives it just one of the inventions it needs.

It doesn't matter what you invent—the world will pay you well for your ideas. Even little ideas, like those shown here, can bring you a fortune. Eberhard who invented the rubber on the end of a pencil, has been paid hundreds of thousands of dollars for his simple idea. The man who invented the metal tip for shoelaces, the man who conceived the idea of the "humped" hairpin, the man, who developed the metal tape measure; all have achieved success and wealth as great or greater than the inventors of large machinery.

Ideas for Inventions Everywhere

Whatever your position in life, whatever kind of work you do, you are constantly meeting problems which must be solved. Even so small an idea as a new kind of kitchen knife for your wife may prove to be the making of your fortune. As an office worker you may invent some little method which will simplify work, or if you live on a farm, you can invent some idea to meet one of your every-day needs.

The work you do, the life you lead, the problems you meet, all present you with innumerable opportunities to invent things. All you need is the ability to think inventively—to train your mind to connect two ideas—just as you connected the idea of the rattling window and the wedge—and you can be assured of success.

Learn How to Invent at Home

Take advantage of the opportunity offered you now. Get the advice and the help of the fifteen famous inventors who tell you all the secrets of invention. Learn how to develop your ideas so they will make money for you.

This is the first course in practical invention that has ever been devised. In simple, easy-to-understand language you are told how successful inventors work; you learn how to think along inventive lines, you learn the short-cuts to successful invention;

you learn how to use the secrets of invention that convert a simple little idea into money.

But you learn more than just how to invent in this fascinating course. Thousands of inventors have lost the profits of their invention simply because they didn't know how to patent and sell their ideas. This complete course shows you just how to apply for a patent, how to protect your rights when your patent is granted, and how to dispose of your invention so you will get the greatest returns possible.

Not one step in invention has been omitted.

Everything you want to know about invention—developing your ideas, securing information you need, how to apply for patents, how to protect your rights, how to sell your invention—are taken up step by step, so that when you have completed the course you have a wealth of information worth thousands upon thousands of dollars.

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A wonderful new book has just come from the press that tells you all about the Science of Invention. It tells you how to avoid the pitfalls that have brought failure to thousands of would-be inventors. It tells you how to learn the secrets of practical invention, which famous inventors discovered only after years of heartbreaking effort and discouraging mistakes and it tells you how to do this in only fifteen minutes of your spare time each day. This fascinating book will be sent to all those who are genuinely interested. Get the advice of these fifteen famous

inventors. Let them tell you how you can easily learn the secrets of successful invention. Send for this Book today as only a limited number are available for free distribution. Send the coupon below NOW, or a letter or postal card will do. There is no cost or obligation. This bureau is not connected in any way with patent attorneys or manufacturers. Our only work is to help ambitious men and women to develop their inventive ability—to become successful inventors.

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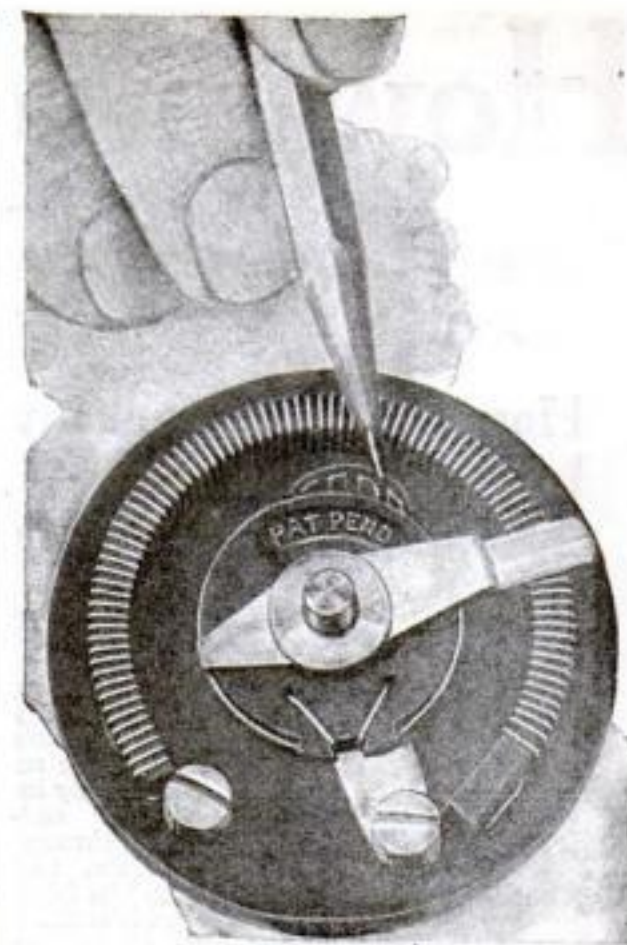
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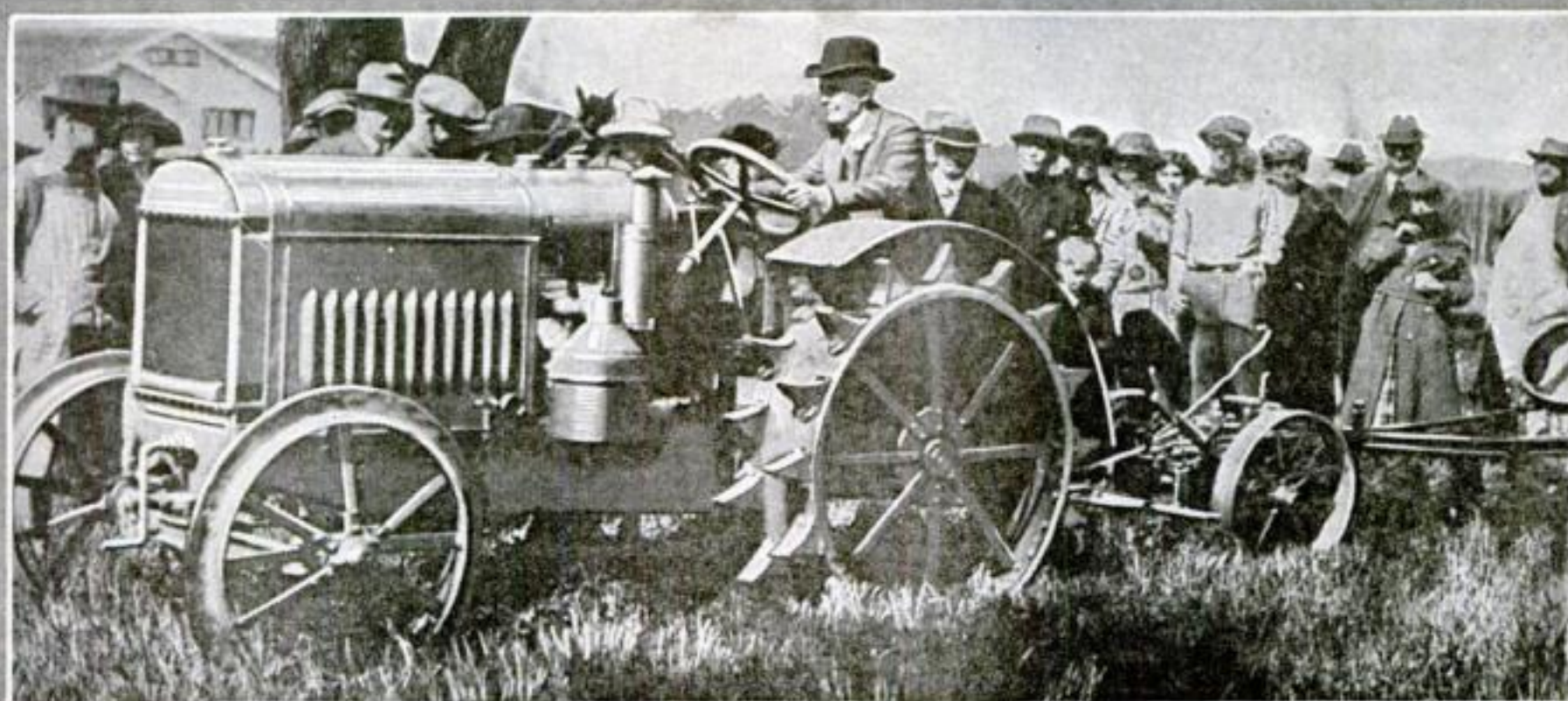
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THEY SAY—

Brief Bits of Timely Comment from Scientists of the Hour



LUTHER BURBANK, famous plant wizard, shown above driving a tractor at the ground-breaking of a 40-acre Luther Burbank Park, dedicated in his honor at Santa Rosa, Calif., during the recent celebration of his seventy-fourth birthday:

"The motor tractor probably will not be surpassed by any other mode of soil cultivation for the next few hundred years, at least.

"On the large farm a good tractor is almost a neces-

sity. Small tractors now are used extensively for orchard cultivation and for small farms, and still smaller tractors have been made for small gardens. Improvements in all these types will make them indispensable in cultivating the soil, although I think the horse never will go out of existence, because of its intelligence.

"In a few cases, landowners have returned to the use of horses after using tractors, but the general tendency is tremendously in the other direction."



DR. KATHERINE B. DAVIS, Director of the New York Bureau of Social Hygiene. Discussing answers to questionnaires recently sent to 1000 married women, most of them college graduates, she says:

"We are certain that in the future scientists will place at the disposal of humanity something that will help it solve the serious problems of sex relationships.

"One of the most hopeful bits of evidence about American social life is that 872 of 1000 women answered, without qualification, 'Yes' as to the happiness of their married lives."

DR. C. W. KANOLT, of the Low Temperature Laboratory, United States Bureau of Standards, who has succeeded in manufacturing solid hydrogen at a temperature of 434° F. below zero, only 25 degrees above absolute zero and probably the lowest and coldest temperature ever reached in the United States:

"Liquid hydrogen is the lightest fluid known. A cork sinks in liquid hydrogen because it is three or four times as dense as this fluid. From the liquid form, the transformation to a solid is only a single step and relatively easy. The fluid is reduced to a lower temperature—about 11 degrees on the thermometer scale—by rapid evaporation.

"Solid hydrogen resembles ice or snow and is extremely light. It is difficult to preserve hydrogen in a solid form for any duration of time."



DR. O. E. HOVEY, of the American Museum of Natural History, New York, examining a specimen of fulgurite, or "petrified thunderbolt," from Mount Ararat, Armenia, recently shown in a special exhibit at the museum:

"Fulgurite is a glass that often is produced when lightning strikes a mass of rock or a bed of dry sand and melts under the impact. In other words, it is a glass made by nature in much the same way that men make glass.

"The phenomenon is known to have occurred at a number of high points in the United States."



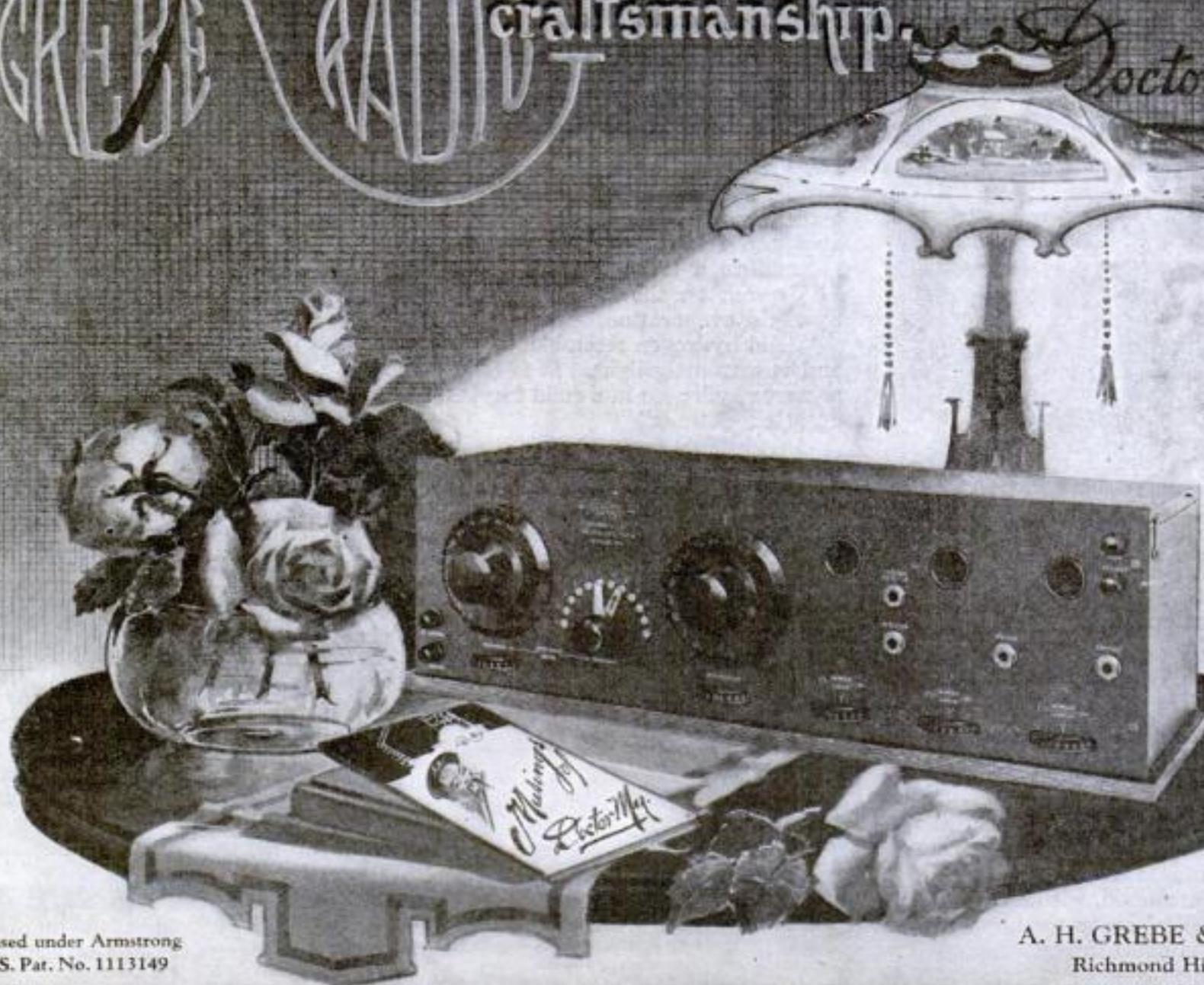
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Richmond Hill, N. Y.



The Circus—A Mechanical Wonder Show

Thrills Made to Order from Levers, Pulleys, and Wheels

By Fred Warrell

Superintendent, Ringling Brothers-Barnum & Bailey Circus

THE lions roar. The elephants trumpet. The clowns cavort. The performers are garbed in glittering spangles. Add the smell of animals and tanbark, and you have a circus in full swing.

Yet few of the spectators realize that mechanics make the scene possible—that without mechanical magicians the circus of today could not exist. Behind its dazzling splendor and delightful odor is highly organized mechanical ingenuity.

Circus "Magic" Based on Mechanics

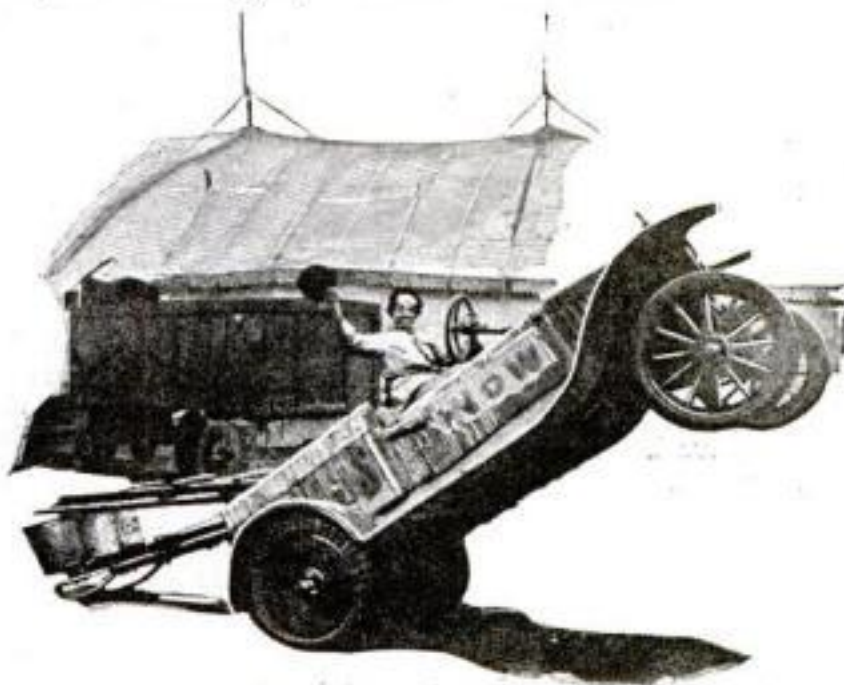
When you consider that the personnel of our circus this year includes 1786 persons, in addition to all the animals of the menagerie, wagons, and paraphernalia—equipment enough to fill 100 railroad cars—the detailed task of transporting, loading, unloading, and assembling such a huge outfit seems almost miraculous. What makes it possible is mechanics.

Most people never think of machinery when they think of the circus. That is because about a tent show is a rarefied atmosphere of splendor, which knows no care and no tomorrow. But behind it all are the five fundamental mechanical principles upon which the business of the modern circus is built and upon which its success depends:

The lever principle we use in our stake pullers; the pulley, in the block and fall; the wheel and axle, in turntable devices; the inclined plane for loading the circus train, and the screw for jacking up mired wagons. Behind our successful and most spectacular acts is an elaboration of one or more of these same principles.

Take for example, Buck Baker, the star clown, whose trick automobiles are known wherever the circus is known. He depends almost entirely on machinery to throw his audiences into spasms of mirth. More than 20 years ago Baker made the crowds laugh with his trick bicycle. In those days you may have seen him in a parade, nonchalantly riding his bicycle on its rear wheel with the front wheel spinning in the air.

Baker developed and elaborated on that original idea, using first a bicycle then an



Let 'er buck! Here is Buck Baker, famous circus clown-mechanic, riding his amazing trick auto that rears on its hind wheels and obeys his call

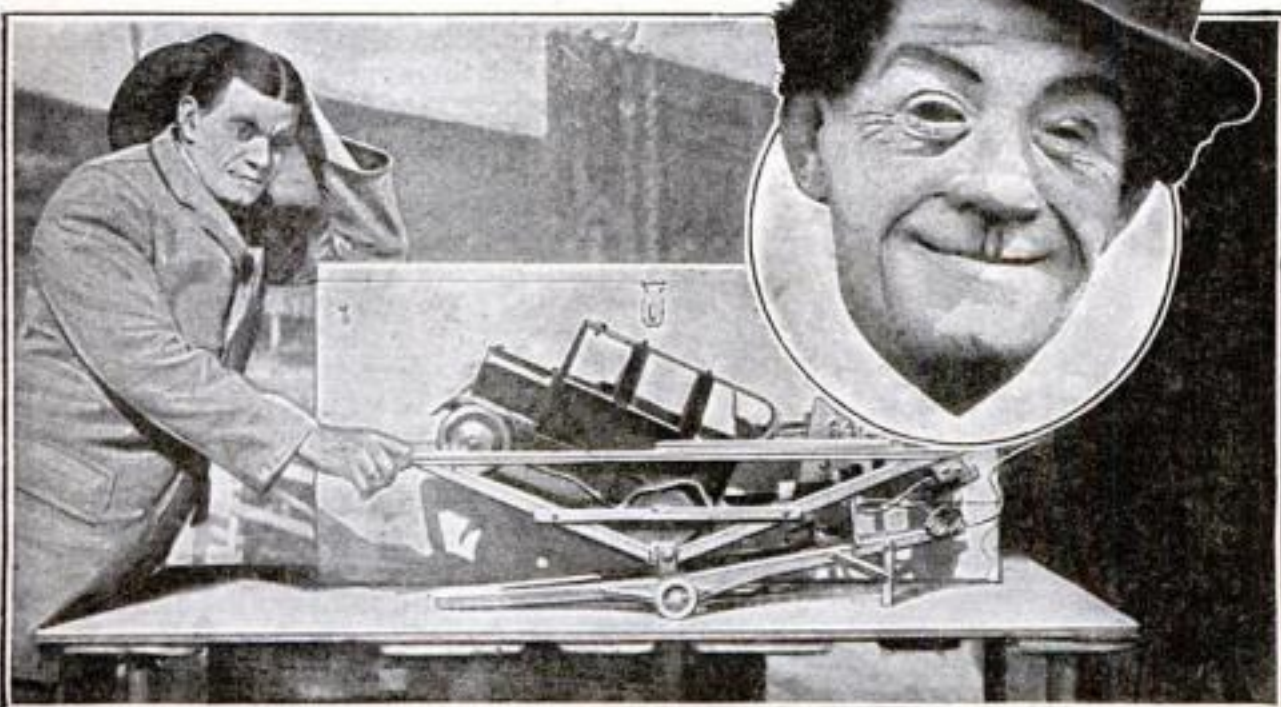
automobile, until today his trained flivver is one of the most amazing properties in the show. He has invented more than a score of clever devices for this car, each one of which required expert mechanical skill. The flivver appears almost human. It can run on its hind wheels, go backward or forward, start and stop without a driver, come when it is whistled for or called, rear up like a horse and squirt water from its radiator. Finally, as if seized with a sudden fit, it seems to blow to pieces without actually damaging itself.

Baker's Tricks Prove Valuable

When Baker first devised a counterweight to make his car run on its hind wheels he found that the gas wouldn't run uphill to the carburetor. He built an auxiliary gas tank in the radiator. Then he found that the oil ran out of the transmission box. He installed a special pipe and washer arrangement to make it run back again. But his crowning achievement was the invention of blank cartridge guns, operated on the principle of the spring rat-trap, to cause exaggerated explosions in the flivver. He used the same apparatus to release fastenings at the right moment so that the car seemed to blow to pieces.

One of Baker's best stunts is to stand off about 50 feet from the car and call it to him. Just how he makes the flivver obey is his own secret. "It's just a simple matter of mechanics," is all he will say.

From experiments with this trick car Baker has perfected an automobile hoist that is now on the market. In repairing his car on the lot at Memphis a couple of years



A model of the mechanical automobile hoist that Buck Baker perfected for use in repair shops as the result of his circus antics with his trick flivver. The

invention is a rocking cradle that tilts a car end up. Buck is shown (at the left) in civilian clothes and (at the right) in characteristic clown make-up

ago, he raised it on its back wheels. The idea came to him that a device for tilting cars in a similar manner would be extremely valuable in garages or repair shops; so he invented the hoist.

With the help of the boss electrician, Baker also built a miniature fire department, used in the show. He worked on this for four months last winter. The fire trucks are complete in every detail, with four speeds, self starter, electric light system, and engine for throwing a stream of water from a two-inch hose. Besides amusing the crowds, the apparatus actually affords fire protection during the show. Now Baker plans to improve the miniature trucks and put them on the market as fire protection for large industrial plants.

Thrillers Made Safe

Just as inventive genius has developed Baker's clown act, so has it improved and safeguarded almost every act in the show. You go to the circus to watch the animals and performers; but actually our mechanics are the show. We couldn't operate without them.

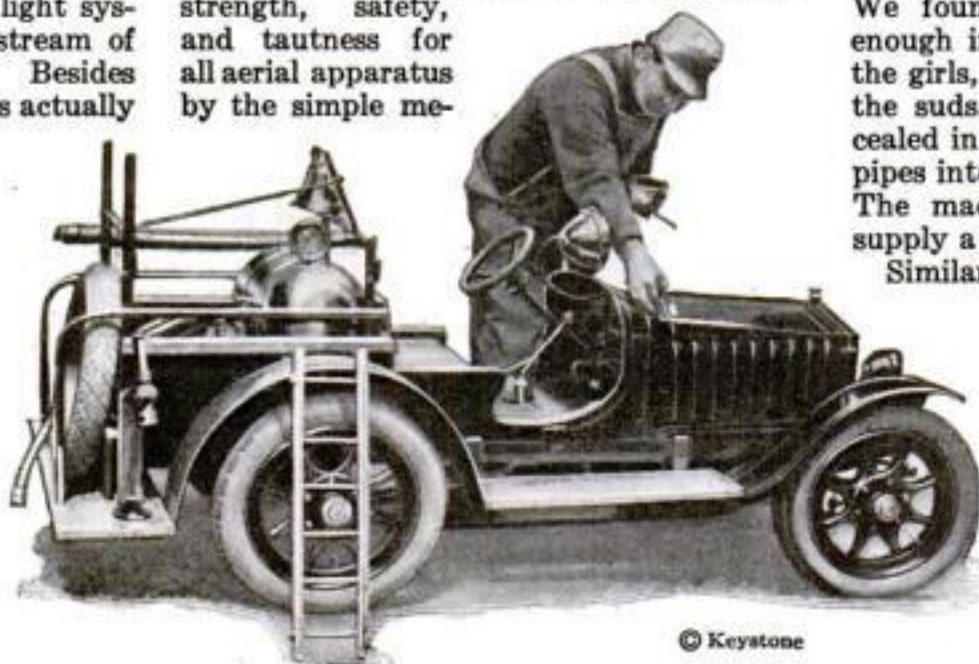
Consider the animal acts that have been our stand-bys for years. Once our chief problem was to offer something new each year. Now our mechanics supply the novelties. You have an expert mechanic to thank for your amusement in watching bears ride bicycles. This expert worked a year making one bicycle. His difficulty was to build a wheel light enough to be handled by the bear, strong enough to hold the animal's weight, and at the same time one that would fit. A bear can't bend over like a human on a bicycle. He must sit upright—really stand. The seat, handlebars and pedals had to be designed carefully to suit him. The position of the handlebars, made in the shape of small forks in which the bear lodges his paws, and of the pedals, in the form of wooden cylinders, was changed dozens of time before it was exactly right.

Even the tumbling dog depends on mechanical devices to perform his stunts. His landing platform is an ingenious arrangement of springs inclosed in pipes concealed beneath a covering. When he lands, the springs give and rebound, aiding the dog in his work.

The first "living statue" acts staged by the circus sometimes were spoiled by the jerking motion of the old style turntables that threw the horses and riders out of their rigid balance. To overcome this, we went back to the old wheel-and-axle principle of mechanics and created a table mounted on a platform made of angle iron. The apparatus is operated by means of a crank and ratchet engaging a circle of pins that turns the top on roller bearings. The thing is so nicely balanced that a man concealed beneath it can operate it with one hand at a slow, even speed.

Mechanics have been responsible, too, for the safety and perfection of modern aerial acts. As these acts became more daring with an increasing number of performers, we found that the old style apparatus wouldn't do. This was proved in

Flint, Mich., about 15 years ago. At that time we used a chain block hauled on by a big crew of men to tauten the tight wire apparatus. One night a link of the chain snapped, hurling the performers into the life net. Part of the broken block and chain hit our boss property man in the head and nearly killed him. Since then he never has used a chain because of the difficulty in detecting flaws in the links. We now obtain strength, safety, and tautness for all aerial apparatus by the simple me-



The world's smallest motorized fire truck, designed for the circus midgets' fire department by Buck Baker, clown-mechanic, with the aid of the boss electrician. The machine is complete in every detail. Its hose throws a powerful two-inch stream of water

chanics of a triple block and fall, which in turn is hauled on by a double block, so that one man can exert a pull of several tons. Much unnecessary labor as well as danger of accident have been eliminated by this method, since ropes are easily inspected.

Another accident that taught us a lesson in mechanics occurred in Albany, N. Y., three years ago. We were using the usual hook arrangement on a block and fall for suspending a gag to be gripped between the teeth of performers in a teeth-swinging act. We had a tape mousing over the hook and to all appearances it was absolutely safe. On this night, however, the ring slipped out of the hook and was supported only by the tape mousing. When Beatrice Sweeney, one of our star performers, let go with both hands to swing by her teeth

she fell 35 feet. She was in the hospital 12 weeks and that was the end of the hook-and-mousing arrangement. In place of hooks we now use wire loops fastened into the iron strap of the block.

Mechanics again came to our aid when we put on our big soap bubble spectacle. The idea was to have a large egg-shaped float on which about a dozen girls would stand and blow bubbles up to the crowds. We found we couldn't make suds fast enough in the ordinary way to supply all the girls, so we invented a machine to mix the suds. This consists of a motor concealed in the float which blows air through pipes into a trough filled with soapy water. The machine can make enough suds to supply a hundred bubble blowers.

Similarly, it is mechanical ingenuity that enables us to remove so quickly the big steel arenas in which the lions and tigers perform at the opening of the show. These cages are made in sections 16 feet high by four feet wide. They are fastened together by special clamps that make the whole structure secure without the use of bolts or nuts. The clamps cannot be loosened unless they are tapped in a certain way. While they hold as solidly as welding, they may be removed in about a second, affording the speed necessary to get the cages out of the ring for the next act.

Many people regard the circus as a makeshift amusement enterprise, here today and gone tomorrow. As a matter of fact, it is a highly organized business, the transitory nature of which depends primarily on the mechanical efficiency of its workers and their inventive genius.

For example, it would be impossible without mechanical skill simplified to the last degree, to conjure up a large tented city from a vacant lot in three hours!

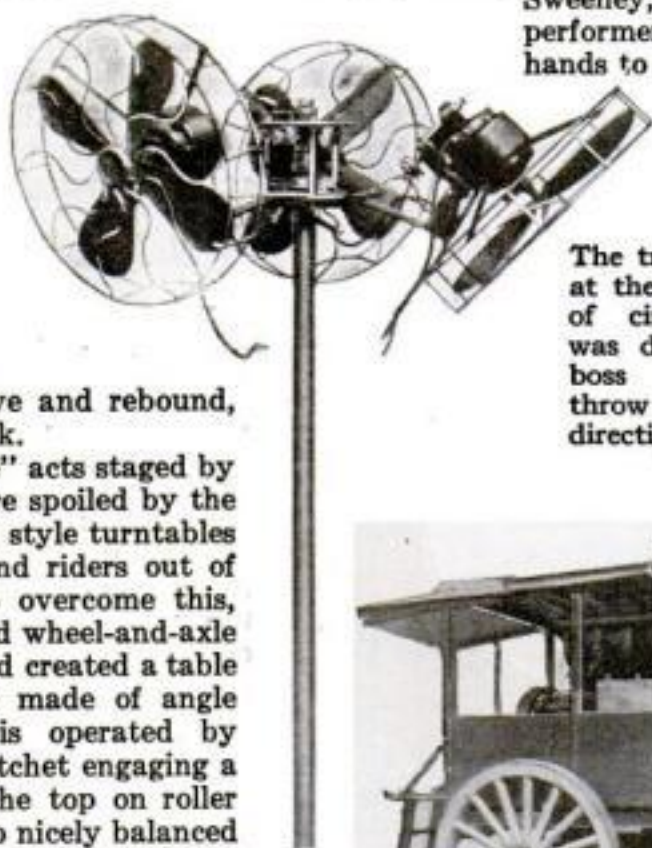
How the "Big Top" is Erected

In the old days, with a small tent, the boss canvasman had little trouble putting the show up by hand in one piece. As the tents grew in size—today our big top is 510 feet long by 210 feet wide—new methods had to be devised. Our big top now consists of 18 sections of canvas, the size of the center pieces being 100 by 60 feet. With their iron rings and ropes attached, each of these sections weigh 1500 pounds when dry and more than 3000 pounds when wet. We lace them all together on the ground and hoist them mechanically as one piece.

Our boss canvasman uses the block and fall exclusively for this work, employing a crew of 190 men. The first thing he puts up is the "king" pole—the first of the center poles. This is the key for all the hemp girders of the circus tent. We use ropes for girders, where other builders use steel or wooden runners.

The king pole is hoisted by means of a series of "bull" poles driven into the ground to form an abutment and also an anchorage for the block and fall. The pole is raised a little way by hand and then the block and fall pulls it up. The king pole then acts as a derrick by which the other five center poles are raised.

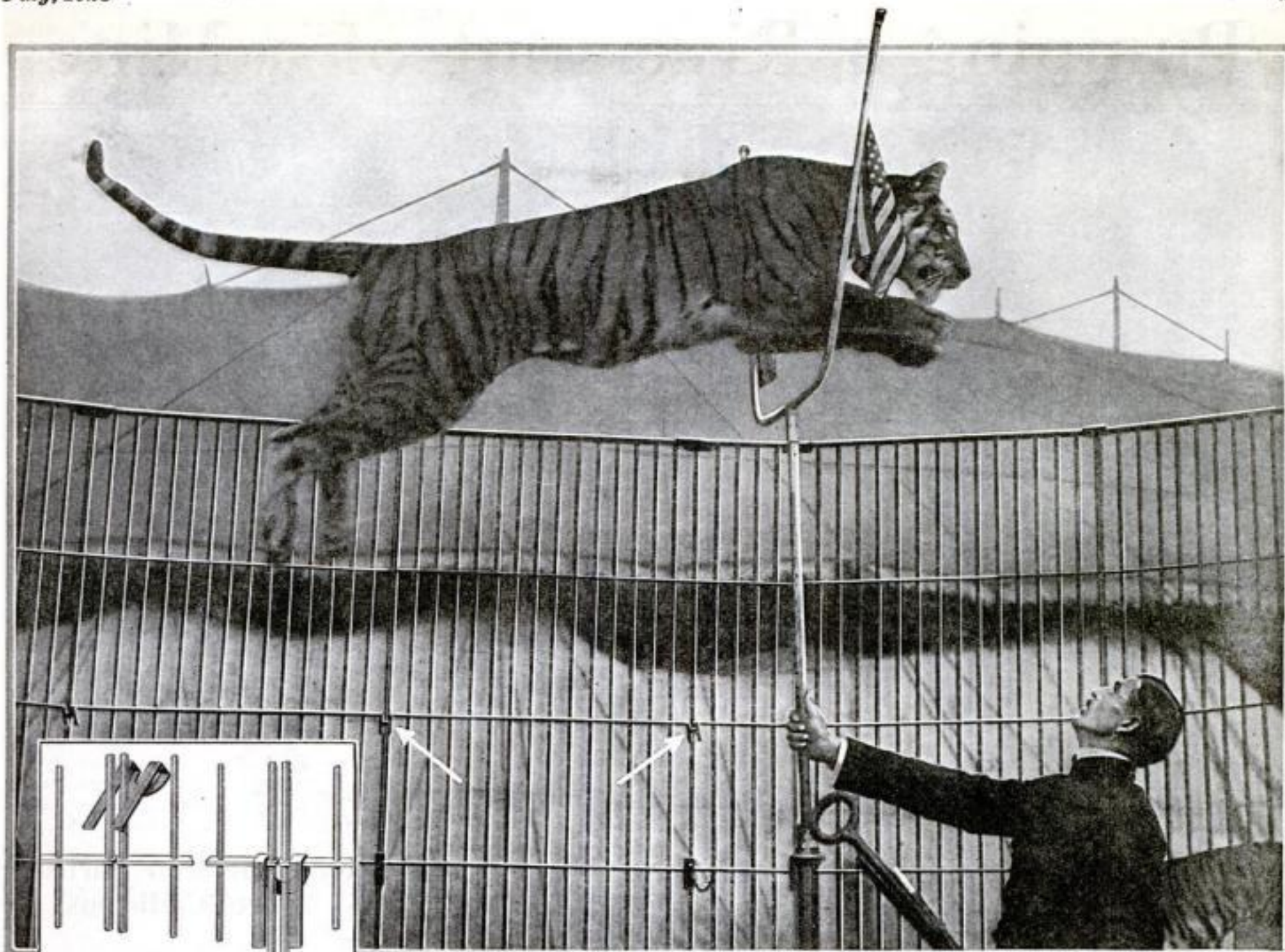
Each pole is encircled by a bailing ring to which the canvas of the big top is fastened. The top is then run up by block and fall,



The triple electric fan at the left, a product of circus ingenuity, was designed by the boss electrician to throw breezes in all directions during the big show



The circus power plant. This is one of four wagon generators that supply electricity for the lighting and ventilating systems



When the tiger leaps the hurdle in the big cage, spectators can enjoy all the thrills without fear of danger, thanks to a cleverly devised clamp that fastens the sections of steel bars together securely without bolts, as shown in the inset. The picture shows the cage during practice, without the top bars

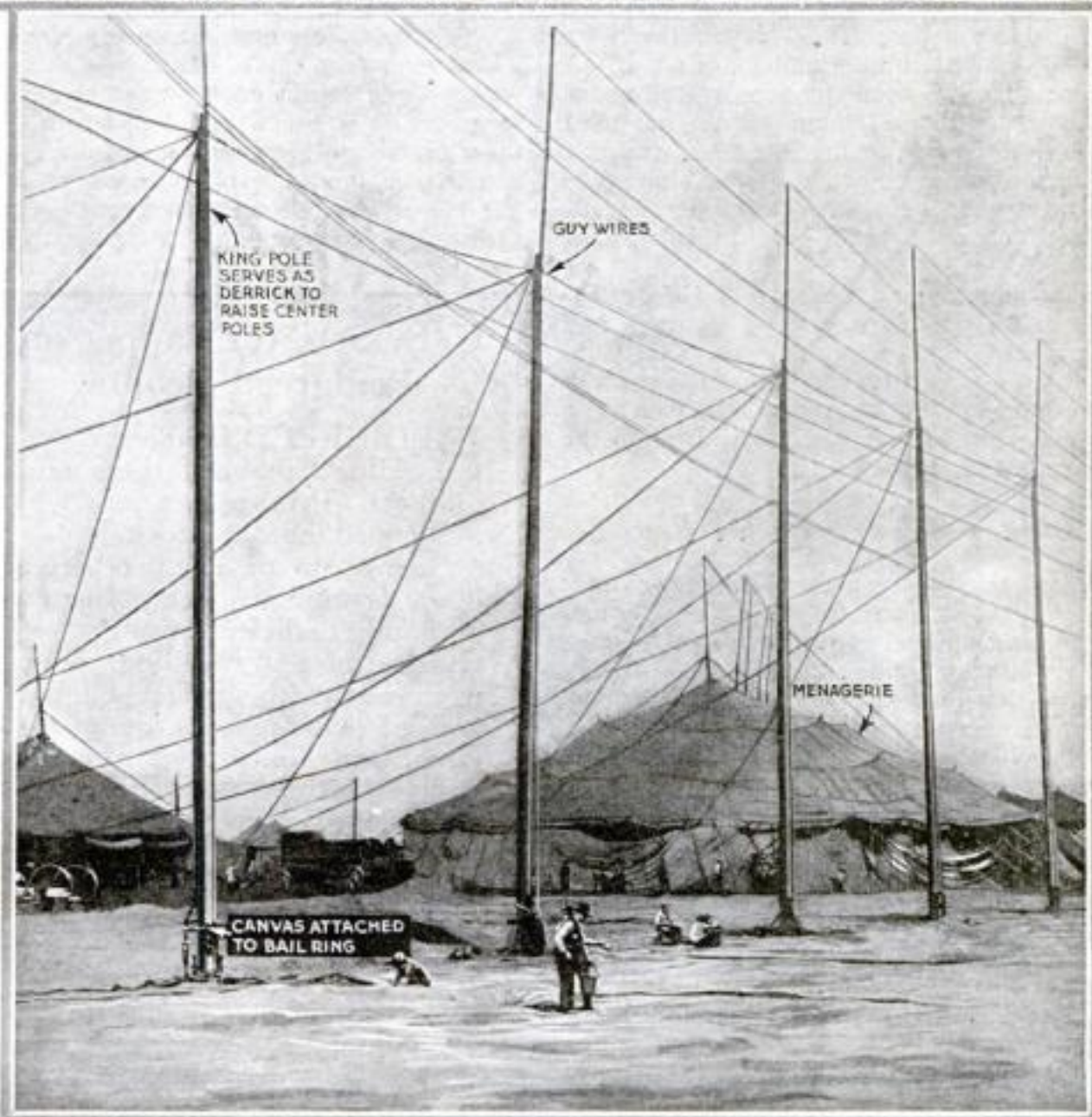
the mechanical stake driver and sledge crews in the meantime having driven the anchor stakes to hold the tent canvas rigid.

As soon as the big canvas clears the ground, the seat crews get busy. We use just three pieces in our seats—jacks for supports, stringers resting on the jacks, and seat boards resting on the stringers. All are fastened together with clamps and they go up like magic. When they are in place, they are as strong as any grandstand, because they are built on the same mechanical principle. In all our experience they never have collapsed.

Accompanying the seat crews beneath the rising canvas are the electrical crews. Electricity long ago replaced the flaming gas torch in the circus lighting system. Cables from the four big generators we carry with us on wagons are strung into the tent and leaders are fastened to bail rings. These rings carry the lights overhead and the whole lighting system is up in a jiffy. The electric calliope is plugged in, the fans are connected, and we are ready for the big night.

Electric fans for the circus are a new departure this year. When we sought to obtain a fan that would throw breezes in every direction, electricians told us no such fan could be manufactured. Our boss electrician wasn't satisfied with that answer. He wanted the fan so badly that he invented one himself, and had 70 of them made for us by manufacturers of electrical

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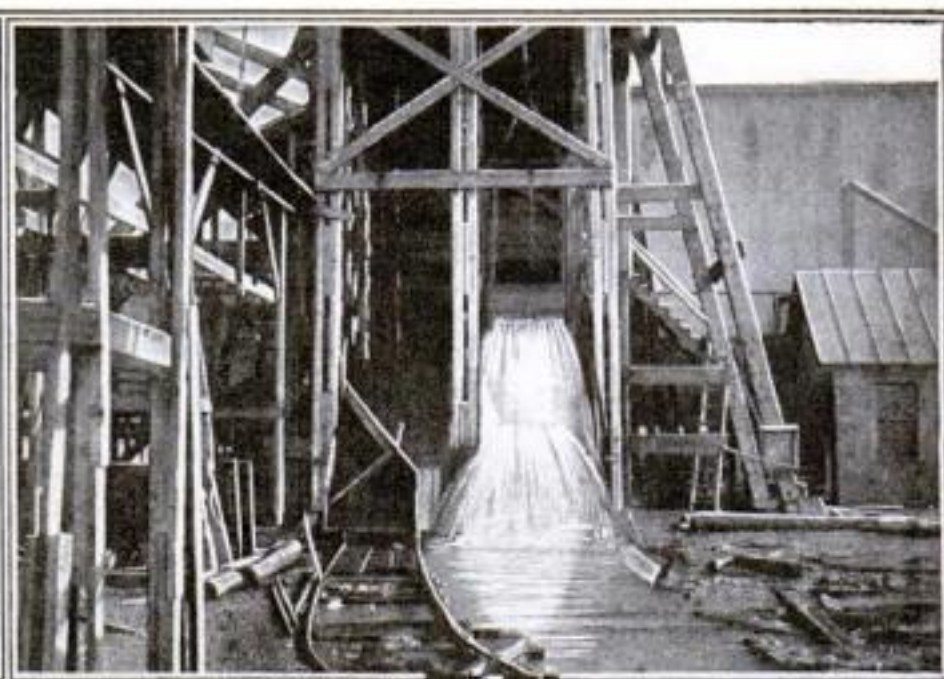


Raising the big top. First is hoisted the "king pole," which serves as the key for all the rope girders of the circus tent. The king pole then serves as a derrick to raise the remaining center poles. The canvas, in 18 huge sections, is spread on the ground and fastened to the poles through bail rings, as shown above. Finally, the top is hauled up the poles and anchored by a mechanical stake-driver. Meanwhile the seats are being erected by crews of workmen

Pumping a River out of a Mine



This lake, covering almost an acre, was formed when flood waters broke through the slate roof of the mine, flooding the workings



Courtesy Coal Age

Novel Water Hoist Saves 300,000 Tons of Fuel

Above, the water boxes in action, hoisting 3,000,000 gallons a day from the flooded mine. The boxes, equipped with flap valves, were lowered down the mine shaft

WHEN flood waters of the Big Muddy River suddenly roared through a break in the roof of Coal Mine No. 9 at Murphysboro, southern Illinois, a few months ago, engineers said the mine was doomed. The workings were flooded with a billion gallons of water. A lake, covering about an acre, rested above the underground chambers at the point where the break occurred.

It looked as if 300,000 tons of high grade Murphysboro coal and at least \$50,000 worth of mine machinery and trackage were lost.

But nobody had reckoned on the ingenuity of W. J. Jenkins, general manager, and C. L. Moorman, chief engineer, of the Consolidated Coal Co., of St. Louis, owners of the mine. While engineers smiled at their nerve, they set out to hoist and pump the river out of their mine!

Owners Invent Salvaging Process

And they succeeded. With ingeniously devised hoist boxes, each holding 700 gallons, and with electric centrifugal pumps, they dipped and pumped that billion gallons out, at the rate of about 5,000,000 gallons every 24 hours.

Previously, with layers of brush, timber, mattresses and earth, they had plugged the deep hole in the mine roof formed by in-rushing waters. With timbers, earth, and hay, they also solidly blocked the underground passages leading from the hole in the roof, making the mine practically watertight, even while the small lake remained at the surface above.

The ingenious apparatus used in dipping the river out consisted of two 700-gallon water boxes, each equipped with a bottom flap valve, and a hinged end gate that opened inwardly by a double crank mechanism. These boxes were hung in the hoist shaft and lowered alternately into the flooded workings. The filling and discharge of the boxes were automatic.

For two months the boxes were in

operation 24 hours a day, making an average of three hoists a minute and discharging about 3,000,000 gallons a day. In addition, an electric centrifugal pump mounted on a platform in the airshaft ejected about 2,000,000 gallons a day in a steady stream.

As soon as the shaft bottom was clear of water, three steam pumps near the shaft were reclaimed and put in operation and two more centrifugal pumps were installed.

The machinery has been recovered, and the 300,000 tons of coal is now coming out of the shaft at the rate of 1000 tons a day.

Opening in Stair Partition Averts Collisions



Showing how hole saves a collision

SHARP turns on stair landings are sometimes the cause of serious accidents in factories and other buildings in which many persons have to use the stairways.

A busy employee, carrying a heavy load, hurries around the corner and collides with a man descending from an upper floor, because he did not see the man in time to avoid the accident.

If a hole is made in the partition between the two flights of stairs, those going up can see and be seen by those coming down and collisions will be averted.

U. S. Senator Capper on Pedigreed People

PEDIGREED families. Blue ribbon fathers and mothers. Prize babies.

Blooded human stock.

Science, in developing better herds of animals, has perfected a highly efficient system of registration and breeding. But what about the better human family? Our records, our pedigrees, are limited at present largely to the family Bible and the Social Register.

In next month's issue of POPULAR SCIENCE MONTHLY, Arthur Capper, of Kansas, leader of the farm bloc in the Senate, will describe a remarkable experiment his state is making in eugenics—the science of fitter families.

For years Senator Capper has worked for the welfare of Kansas. When he speaks of Kansas, he speaks of his own, and with authority.

Will Power—Man's Best Ally

New Science Reveals that Health and Success Depend Largely on Ability of the Mind to Summon Reserves of Human Energy

By James J. Walsh, M. D., Ph. D.,

Professor of Physiological Psychology, Cathedral College, New York

THE other day, when Christy Matthewson, one of the greatest baseball pitchers in history, returned after a long absence to his old haunts at the Polo Grounds in New York, he was greeted as the hero of a contest eclipsing even those famous diamond battles of old, when he pitched the New York Giants out of many a crisis.

It was the contest of one man's will power against disease.

At the pinnacle of his fame, "Matty" left the baseball diamond to grapple with the most relentless opponent of his career—the great white plague. He returned victorious, as part owner of the Boston club of the National League.

Why Matthewson Won

His dramatic "comeback" was just one more striking demonstration of what will power can accomplish for the man who makes up his mind to do a thing.

How did Matthewson win where countless others have failed?

Simply by calling on latent reserves of energy within himself—by exerting sheer will power to tap successive layers of hidden and unsuspected strength.

"Tuberculosis always takes the quitters first," he heard his physicians say.

"Matty" simply refused to be a quitter.

Every baseball fan knows of the valiant fight that followed; of how the man who time and again had pitched his team to victory matched the power of his will against disease. It was no soft job for him to renounce a spectacular career; to live a recluse life out of doors in the bitter cold of winter and in the heat of summer; to eat what he didn't like; to obey physicians' orders; to keep from worrying, and even to deny himself the news of championship ball games. But he had the will to go through with it; and he won.

This ability to lay hold of secret storehouses within ourselves—this quality we call will power—is man's greatest asset. By exercising it, we can attain health, happiness, and success in their fullest measure.

We use the phrase, "making up our mind," but what we mean is, "making up our will." This "making up our will" and using it as a whip to drive the body beyond the point of first fatigue is as much a factor of



Christy Matthewson, former world famous baseball pitcher of the New York Giants, who by sheer will power won an uphill fight against tuberculosis, and who now is part owner of the Boston club of the National League

success in everyday work and play—in the workshop, in the office, or on the athletic field—as it is in the fight of science against disease. Most people believe any such

grow lighter. He discovers all at once that he can go on for another prolonged period. He has his "second wind."

Marathon runners sometimes get a third and even a fourth "wind," continuing on their course when it would seem humanly impossible. And, strange to say, this drawing upon the deeper layers of unsuspected energy, leads not to exhaustion but to larger usefulness and availability of natural energies.

This was proved by a committee of eminent physicians who examined contestants in the recent American marathon at Boston, Mass. The examinations revealed that the runners suffered no ill effects from their 25-mile grind. More significant still, there was no trace of the so-called "athletic heart." That bugaboo of athletes was proved to be a myth by comparative X-ray photographs of the runners' hearts at the start of the race and at the finish.

UNTIL recently we knew as little of the human mind as a lightning bug knows of electricity. But modern science is discovering in it resources of hidden power that hold the secrets of happiness, health, and success.

In the series of articles, of which this is the second, Doctor Walsh, one of America's most noted physicians, tells what scientists are learning of these unseen forces. He shows how we can control and use them.

Next month he will write on autosuggestion. He will tell what it means and in simple terms will show how the average person can use it scientifically to get the most out of life.

exertion of the will is quite impossible. That is because they never have tried seriously to use their wills. But athletes know that in striving for new records, they must train not only their muscles, but their wills as well, if they are to accomplish what they set out to do.

William James, noted professor of psychology at Harvard University, used to emphasize the place of the will in human life by referring to what is known in athletics as "second wind."

In the course of training, nearly every athlete reaches a point where, having run a certain distance or accomplished certain feats, he seems unable to do more. His breath grows short, a sense of tightness comes around his chest, his heart seems to be crowded, his feet become heavy. He feels as if he must give up.

"Second Wind" Explained

Here is the crucial test. If he lacks the mental stamina of an athlete he will give up. If he is unable to exercise will power to draw further on his energy resources, he never will become a successful athlete. But if he pushes on, confident that his heart, lungs and other organs are in good condition, and determined to go the limit of his powers, a remarkable thing happens. His breath begins to come easier, the tightness around his chest is relieved, his heart seems to act with less effort, his feet

One of the most interesting disclosures of the test was that the winner, Clarence De Mar, although possessing unusual wind power, had less of it than other runners who finished far down the list. This tended to prove that in the exertion of driving the body's physical strength is secondary to will power and that a man of ordinary physique often can achieve goals far beyond his apparent ability if he exerts the strength of will.

Most of us fail to put forth our best efforts because we do not train our wills to accomplish the utmost that they can. We stop at the first barrier of fatigue. In matters of health, this becomes very important. The man who has failed to develop his will as a reinforcement against the inroads of disease, often gives up and dies, where another man, by tapping his deeper layers of energy, not only conquers the disease but lives on for many useful years.

Fear May Cause Death

In modern practice competent physicians everywhere recognize that the will to live is an all-important factor in any cure. Thus a patient is carefully guarded from news that might cause discouragement or fear of dying—such as news of the death of another person suffering from the same ailment. Any physician will tell you that the patient who gives up is the hardest of all to cure.

In pneumonia, this will to live is extremely important; for the nature of the disease tends to scare the patient. Rapid breathing, and a heart that is laboring to pump blood through a congested lung are symptoms that terrify any but the strong willed. By preventing the patient's using his vitality to the best advantage, the fear itself may be the actual cause of death.

Overcoming of disease is only one phase of the application of will power in the business of living.

Consider your own case for a moment. Go over in your mind the things you shirked or left only half done today because they were hard. Ask yourself whether you put your best effort into your tasks. The result of this self-examination may surprise you.

Wishing and Willing

I have talked with young men who believed they were putting their best into their work, yet complained that they were not attaining the success they believed was their due. On close questioning I have found invariably that they were accustomed to do well the things they enjoyed, but that they shirked the part of their duties that required effort. They just couldn't force themselves to do the disagreeable things.

A salesman I know was a typical example of this class. He had exceptional ability and closed a high percentage of his prospects; but he never headed the list of salesmen of his firm in amount of business. In talking with him, I discovered the trouble. He was in a rut. He had formed the practice of limiting his work to certain hours, beyond which he could not work. He

figured on making just six calls a day. Even if he were successful in these, he never would make the seventh call. He considered he had done a day's work and couldn't force himself to do any more.

I saw him recently and he told me he was leading his firm in sales. When I asked him if he had changed his sales arguments, he laughed and said,

"No, just my habits."

This young man had checked up on himself and had found that he was becoming grooved in the "pretty good" class simply because he lacked the will power to do things he didn't like to do, such as working after 4 P.M. and before 10 A.M. He made up his mind to



The Will to Win

Grim determination, expressed here on the face of Bob La Gendre, famous track athlete of Georgetown University, won for him the Pentathlon—the intercollegiate all-round athletic championship in 1919, 1921, and 1922. He won by exerting his will power to draw upon hidden reserves of energy

work harder; to extend himself. The result was that he discovered he could call on many more prospects in one day than he had believed possible.

Many inventors are like this salesman. They conceive wonderful ideas and half

work them out. Then they shelve them, always intending to complete them, but never exercising the will power to overcome the obstacles that caused them to "put off."

The popular belief that a man must have a strong body to have a strong will is erroneous. Theodore Roosevelt was somewhat delicate and weakly as a boy. Only his indomitable will enabled him to use every energy and to rise to a position of extraordinary power and influence.

Will Power in Marathon Dance

Sometimes the force of an original idea will stimulate in a person the sudden development of amazing will power. During the recent craze of marathon dancing, numbers of young men and women who never before had exhibited any great amount of reserve energy, proved, under the stimulus of the idea of endurance, to have powers that no one, least of all themselves, ever thought they had. Will power gone to waste, perhaps, but will power, none the less.

Most of us fail to distinguish between *wanting* to do a thing and *wishing* to do it. Indeed, many persons, when they say "I want to do a thing," mean they would like to do it, but they feel that they cannot do it. That is why M. Coué, the druggist healer of Nancy, France, declares that when the will and the imagination come in conflict, the imagination always carries off the victory. What he really is referring to, however, is not the *will*, but the "wish" to do something with the feeling already half aroused that it cannot be done.

Extent of "Will Cure"

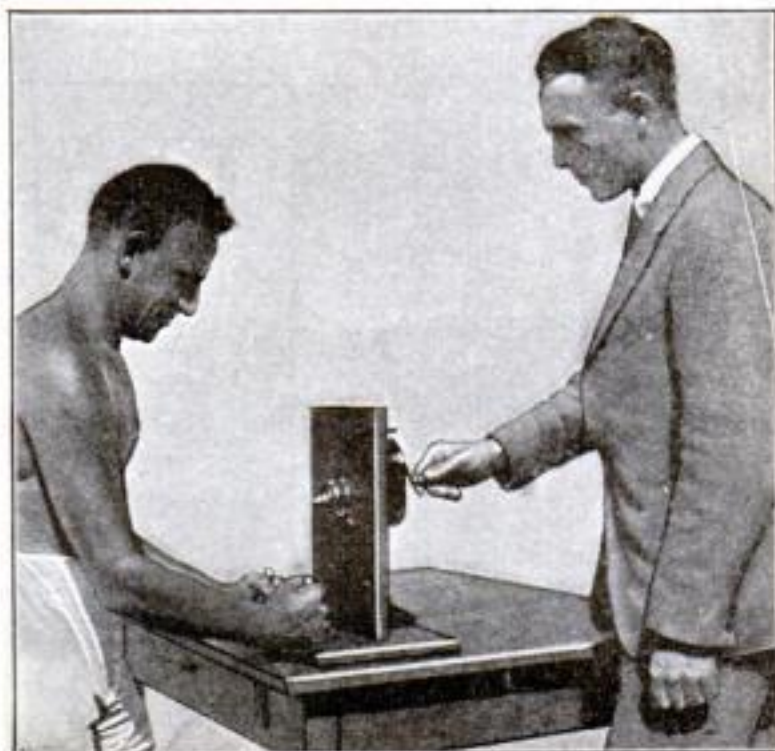
Coué's successes in healing by autosuggestion simply show what can be accomplished by will power once a person's mind is brought into a favorable condition for the employment of it. Patients who had been miserable apparently were restored to health by Coué, after their wills had been aroused to enable them to throw off their affliction.

The average person can cure almost any common ailment if he will really set his will to the task. He may not be able to cure cancer or organic disease in this way, but he can cure most of the functional diseases and relieve symptoms, even of the severe organic affections.

And—anybody can cure his own laziness, at least. That is one of the most important cures in life.

Machine to Test Will Power

THIS electrical apparatus for testing human will power and energy was perfected recently by Dr. R. W. Schulte, psychophysicist of Berlin, Germany, who claims to have demonstrated that will power and health go together. In the test the athlete grasps two conducting rods, through which bodily energy is said to be converted into electrical power to run a small dynamo. The rate at which the dynamo is forced to run, it is claimed, measures the will-energy of the subject. The photograph shows Dr. Schulte's apparatus and how it is used during the test



Blazing the Trail for Polar Airlines

Daring Explorer Attempts to Fly 2000 Miles across Frozen Arctic in One Jump; May Shorten Travel Routes

THE whole world this summer is watching with interest the daring attempt of Capt. Roald Amundsen to fly 2000 miles across the frozen wastes of the North Pole without a stop.

If the famous explorer succeeds in jumping by airplane from Point Barrow, Alaska, to the island of Spitzbergen, just north of the Scandinavian peninsula, he will have opened up an Arctic airline that will shorten transportation distances from North American cities to Europe and Asia by thousands of miles.

While flying experts are predicting an era in which travel by air will be as commonplace as travel by water or land is at present, it remains to be seen whether airships will be able to use the shortest routes between various points on the globe or whether they will be obliged to follow the longer routes in the temperate zones. Should Amundsen be able to jump from the eastern to the western hemisphere over the top of the world



Here is the giant monoplane in which Capt. Roald Amundsen (standing in the center of the picture) is attempting a 2000-mile non-stop flight this summer over the North Pole, from Point Barrow, Alaska, to the island of

Spitzbergen. The map of the top of the world, above, shows how transportation distances between the world's great cities will be cut if the establishment of arctic commercial airlines is proved by Amundsen to be practical

through a land of ice and snow, where a forced landing means almost certain death, the problem will be solved.

At this writing Captain Amundsen was reported proceeding by dog sled from Nome, Alaska, to his base of departure at Point Barrow. His plan was to make use of the summer solstice, when the sun shines 24 hours a day in the arctic regions. He expected to hop off on his non-stop journey some time between June 20 and 28.

In the 2000 miles between Point Barrow and Spitzbergen lies a territory covered with glaciers 3000 feet deep. Between Spitzbergen and the northern coast of Siberia is a vast area that never has been explored. While Amundsen's immediate purpose is to explore this region, the successful termination of his flight is expected to have far greater results commercially.

By the arctic route, the traveling distance from San Francisco to Petrograd, Russia, which now is accomplished by way of New York and across the Atlantic Ocean, would be reduced to 5300 miles—a short cut of 2200 miles. In making the journey, the longest single jump through the polar region would be 2000 miles, as

compared with the 3000-mile distance by water from New York to Europe.

The success of polar flight will bring all of the world's great cities closer together commercially. While at first glance it might seem shorter from San Francisco to Cairo, Egypt, across the Pacific Ocean, actually 1500 miles would be cut from the journey by crossing the arctic regions.

DO YOU suffer from hay fever? One out of every 100 Americans do, and yet some people think it is a joke.

William M. Patterson, chairman of the executive committee of the United States Hay Fever Association, has prepared an unusually informative and helpful article on this important subject for the August issue of **POPULAR SCIENCE MONTHLY**.

The newly discovered goldfields of northern Siberia would be 2400 miles nearer New York than at present. Amazing progress in the science of aviation may make it possible to tap this rich territory that now lies practically idle because of its inaccessibility.

The shortest air route from London to Tokio is at present 6300 miles. A thousand miles could be cut from this tedious journey if an airplane line were established over the North Pole. Similarly, the distance from Chicago to Archangel, the most northerly port of Russia, could be shortened by at least 1200 miles. Archangel is closed completely for a large part of the year because of ice. The airplane can keep Russia's only western seaport open the year around.

Looking into the future, aviation experts are confident that towns in the polar region eventually will develop into great centers of air transportation rivaling in importance the world's leading shipping ports of today. The inhabitable shores of Greenland, the northern coasts of Alaska and Siberia, as well as such islands as Spitzbergen and Wrangel, may soon become busy halfway stations for intercontinental air lines.

Coast-to-Coast Air Mail—28 Hours!

Record Non-Stop Flight Hastens Day and Night Postal Service

By Norman C. McCloud

LETTERS mailed at New York at noon, delivered in San Francisco the next evening!

When the two army fliers, Lieuts. Oakley G. Kelly and John A. Macready, recently landed at Rockwell Field, San Diego, Calif., completing a non-stop transcontinental airplane flight of 2600 miles from Hempstead, N. Y., they did more than establish a new world long-distance record. They did even more than herald a new epoch of long-distance commercial transportation by air.

By piloting the four-ton army monoplane T-2 from ocean to ocean in 26 hours and 50 minutes, they proved conclusively that all-night air transportation over land is entirely practical. And in so doing, they proved the immediate feasibility of Uncle Sam's plans for the establishment of transcontinental air mail service on a definite schedule of 28 hours, as had been predicted by Brig. Gen. William Mitchell, assistant chief of the Army Air Service.

Viewed simply as a sport contest, the feat of Lieutenants Kelly and Macready is a spectacular triumph for American aviation, which now holds the world's records for altitude, speed, distance, and sustained flight. But its real significance lies in its commercial value. Figuratively, they have shrunk the United States until, viewed in the light of transportation distances, it is a mere township in size compared with the United States of stage-coach days, and one sixteenth the size of the United States of fast mail trains.

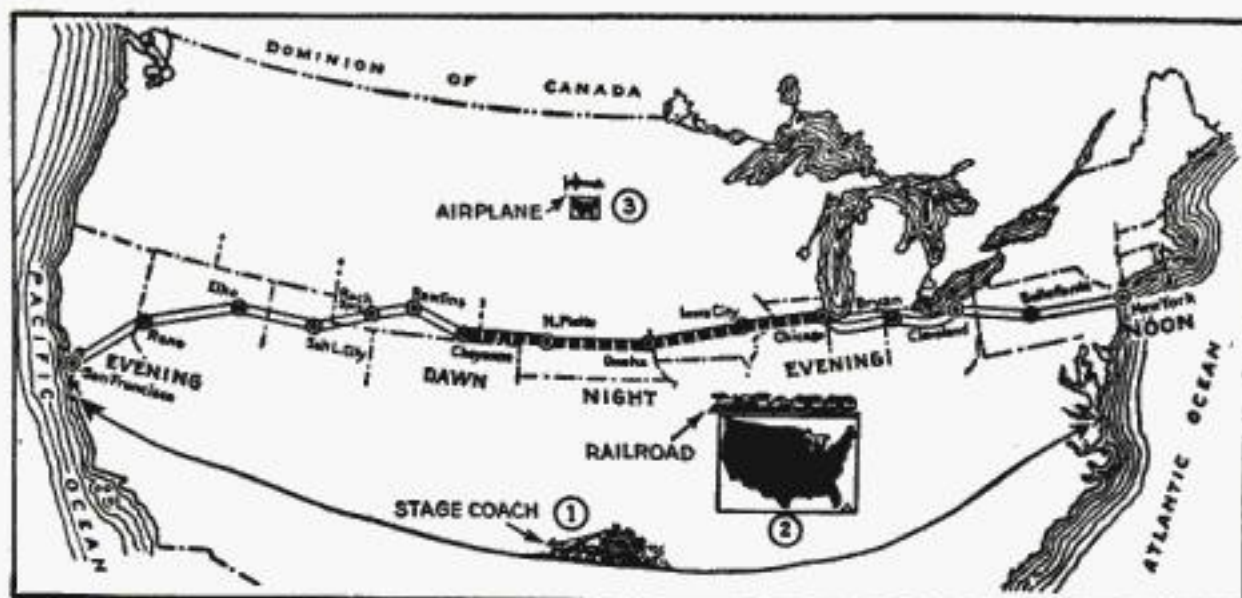
Beacons Guide Fliers

In the black of night, while the 250-horsepower Liberty motor hummed along without faltering, these two army airmen guided their plane above a maze of confusing lights below them, by means of pre-arranged flares. Thus they proved the soundness of the government's plans for lighthouses, established at intervals across the continent to guide air mail fliers.

And so, with full assurances of success, Uncle Sam is now completing preparations for the establishment of day-and-night scheduled air mail service between New York and San Francisco. This service probably will be established before the close of the summer.

Leaving New York at noon the mail planes are scheduled to reach Chicago, Ill., in the evening; Omaha, Neb., at midnight; Cheyenne, Wyo., at dawn, and San Francisco toward evening of the second day. This schedule calls for about 1000 miles of night flying, the total time from coast to coast being 28 hours.

The pilots will be



THIS map shows the route of Uncle Sam's projected 28-hour, day-and-night airplane mail service from New York to San Francisco. The dark portion shows territory to be covered at night. Circles indicate terminal stations, while white bands represent emergency fields. The small maps show how the United States has shrunk in transportation size since the olden days of the stage coach.



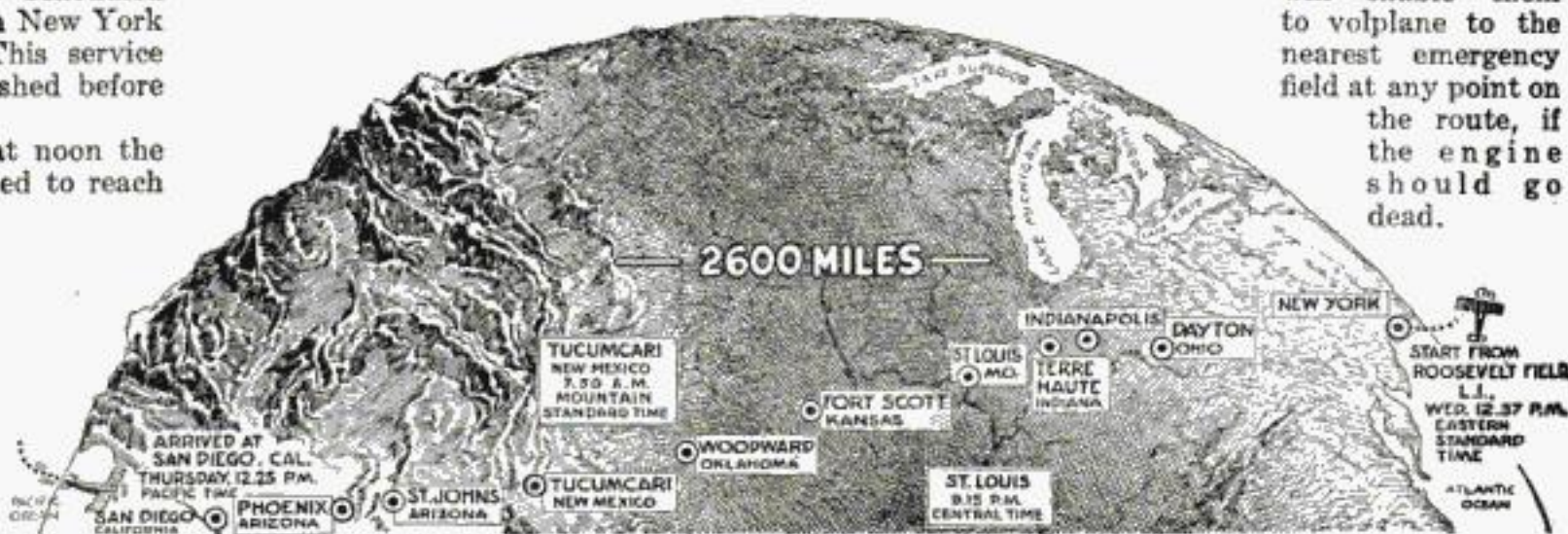
Lieutenant Macready (above) and Kelly (below) with the army monoplane T-2 in which they made their record non-stop transcontinental flight. Lieutenant Kelly is shown standing beside the machine.

guided by a pathway of powerful beacons pointing the way to terminal fields. In addition, emergency fields will be lighted every 25 miles along the route. As a result, millions of people in the Middle West nightly will witness an artificial aurora borealis that will be visible for 50 miles from the five nighttime terminal fields, at Chicago, Iowa City, Omaha, North Platte, and Cheyenne. The beacons at these fields each will have 600,000,000 candlepower. The light will swing around three degrees above the horizon, throwing a strong beam at the rate of three revolutions a minute. The smaller beacons at emergency fields will throw a light of less intensity in a circle. They will be visible for 30 miles.

Sky Traffic Lights

As a final safeguard, flashing traffic lights, like those on city streets, but directed toward the skies, will be located every three miles along the line of flight. Thus on a clear night, the air mail pilot 7000 feet up will see a narrow line of light stretching for miles over level prairies.

It is estimated that the pilots will ordinarily fly at an altitude that will enable them to volplane to the nearest emergency field at any point on the route, if the engine should go dead.



Cities along the 2600-mile route covered by Lieutenants Kelly and Macready in their transcontinental non-stop flight are indicated above. The official time from Hempstead, N. Y. to San Diego, Calif., was 26 hours, 50 minutes.



New York City's \$70,000,000-a-year nighttime display. Hydroelectric power would produce as much light, it is claimed, at one tenth the cost

Rivers of Cheaper Light and Heat

By T. Kennard Thomson
Noted Consulting Engineer

SCIENCE is about to open the door that will release from the waterpower resources of the country 80,000,000 horsepower of energy, enough to heat and light the homes and turn the wheels of the nation.

One obstacle only stands in the way of utilizing the tremendous power flowing in our rivers—that is the lack of a practical means of transmitting electric current at high voltage for long distances.

Already current has been transmitted for a short distance at 1,000,000 volts. Dr. Charles P. Steinmetz, electrical wizard, did it recently in an experiment. He predicts that the same feat soon will be commercially practical.

When electrical power can be carried long distances without waste, engineers say, the power problem of the nation will have been solved. Coal famines will be unknown because coal will cease to be the important factor in the production of power.

The total water-power resources of the United States have been estimated at 80,000,000 horsepower, the equivalent of 800,000,000 tons of coal a year, or 200,000,000 tons more than the total amount of coal mined in the country annually. Thus it is apparent that water alone can supply our power needs for years to come.

At present, current is carried several hundred miles at a voltage of 250,000.

When it can be carried 2000 miles at a voltage of 1,000,000, the scattered hydroelectric plants that now serve local needs can be hooked up in one huge power project and, with new plants to be erected, can put to commercial use all the water power in America.

This plan of connecting individual plants in series already has been adopted on a fairly large scale in a group of Southern states. A single system more than 600 miles long covers the more important industrial areas of Alabama, Georgia, Tennessee, South Carolina, and North Carolina. California has a similar system and New York state engineers are working along the same line.

To grasp the economic possibilities of this development, consider the cost of water power as compared with coal.

A plant designed to utilize one half the water flowing over Niagara Falls is expected to produce at \$15 a horsepower. It takes 10 tons of coal to produce one horsepower. Coal at present costs about \$14 a ton. Therefore water power at the Niagara plant will cost only about one tenth as much as coal power.

Electricity at \$15 a horsepower repre-

sents a cost of one quarter cent the kilowatt hour. That is, 20 ordinary electric lights burning for one hour would cost only one fourth of a cent. Compare this with what you pay at present for lighting your home and you will see what a decrease in light bills may be achieved by use of "white coal."

Next in importance to cost is the utilitarian value of inexpensive power.

With cheaper electricity will come a more general use of household electrical appliances for heating and lighting purposes. Manufacturing and transportation facilities will be increased; farming will become more profitable; the cost of living will be lowered; health will be improved by the elimination of the smoke nuisance. Traffic congestion will be relieved and coal famines will be things of the past.

The greatest single source of power in the United States and the one that probably will be the first to be fully developed is Niagara Falls. That part to be utilized is capable of producing 4,000,000 horsepower. The St. Lawrence River probably will be next in line to receive the attention of engineers. It will produce another 4,000,000 horsepower. Radiating from the Great Lakes section will be thousands of miles of electric lines delivering power to distant parts of the United States.

After the larger power sites have been fully developed, engineers will turn their attention to the lesser rivers.

While geologists tell us that coal will last for 4000 years, it must be remembered that the price increases for every foot we descend into the earth to reach the coal. Water power on the other hand is economically principal energy



How isolated hydroelectric power plants have been linked successfully into one 600-mile power system to serve an entire group of Southern states. Letters indicate location

PIONEER CAVEMEN WHO

How Our Ancestors Gathered Knowledge by Cooperation

Fifth Article in the Fascinating Series,
"The Story of Man and His World"

By E. E. Free, Ph.D.



American pioneer settlers and home-builders, modern adventurers like the ancient New Stone pioneers



Courtesy Paramount Pictures

MODERN life is distinguished from the caveman life of 15,000 or 20,000 years ago by the thing called civilization.

So far as we can determine from the remains that have come down to us, the cavemen were about as clever and inventive and artistic as we are. Their brains seem to have been quite as intelligent as ours. Their bodies, as the result of a more healthful outdoor life, were probably better than ours.

We are better off than these ancient ancestors of ours, not because we have improved ourselves, but because we have improved our world. The substance of this improvement is present-day civilization.

Up to this point in our story of man and his world we have been tracing the origin of life itself and of the human animal. We have considered the probable beginnings of the earth and we have seen how life itself may have begun in the first specks of living matter in the primeval sea. We have traced the descendants of these living specks through a billion years of evolution until they led, at last, to man.

We must turn now from this story of the origin of man to the still greater story of

what man has done in the world, of how he has improved it and civilized it.

Civilization might be defined in a hundred different ways, but the essential thing about it is, I think, the gradual accumulation of knowledge. Let us consider, for instance, how man probably invented agriculture.

The first men, like the apes who had preceded them, merely gathered their food from the free bounty of nature. They hunted for and found those fruits and nuts and grainlike seeds that grew naturally in the forest or near to it, just as modern boys still hunt for sassafras or beechnuts. It never occurred to these primitive men that they could plant seeds on purpose and thus secure more grain. They did not even know what seeds were, nor that new plants would grow from them if they were put into the ground.

But finally, not more than 20,000 or 25,000 years ago, men began to notice things about these familiar grain plants from which they gathered edible seeds in the autumn. In those days the winter stores of grain and the like were kept, we believe, on raised covered platforms, like little huts on stilts, where dampness and

mice or other vermin could not get at the food. One of the things that men began to notice was, perhaps, that underneath one of these raised granaries where grain had been stored during the winter, it was usual for a lot of new grain plants to grow up the next spring.

No one realized, at first, that this was due merely to accidentally scattered seed. They did not know, you remember, anything about seeds. That new growth of grain close to where the old grain had been was a mystery similar to the hundreds of other mysteries with which primitive man felt himself to be surrounded.

The intelligent and serious minded men of those times pondered this mystery of the grain, we may be sure, for years, perhaps for generations, just as modern scientists ponder the remaining

The Constant Climb of Civilization

Our artist's conception of how man has risen in less than 20,000 years from the savagery of the New Stone Age to civilization and the mastery of his world



BABYLONIA
NEW ABOUT 4000 B.C.

STONE AGE
20,000 YEARS AGO



GREECE 700 B.C.

EGYPT
ABOUT 3500 B.C.

IN THE beginning, men hunted and fought. Each man lived for himself. Every other man was his enemy. Gradually men gathered into groups. They built villages,

some of them like the Swiss lake village of the New Stone Age shown at the extreme left. In Babylonia, men founded cities and built great temple towers to honor their gods.

Throughout the ages men have built empires and civilized communities. Then, fighting each other, they have torn down everything that had been built. How long will this go on?

Modern men turned to the conquest of nature. The soldier has given place to the workman and the engineer. Will we fall again to fighting and tear down the civilization we have built?

INVENTED CIVILIZATION

natural mysteries, such as electricity and gravitation. Finally, some forgotten prehistoric genius thought of the right answer. He understood that the old seed and the new plant were related. The way lay open, then, for the artificial planting of grain, the increase of the food supply, and the gradual perfection of the tillage of the soil, which is one of the chief props of modern civilization.

Men Begin to Work in Groups

The point of this story is that the beginning of agriculture was the discovery of the fact that plants grow from seed. After this came the discovery of other facts: facts about how and when to plant the seed; facts about what kinds of seed were best to plant, facts about what kind of soil to use and how to prepare and tend it. Agriculture, even today, is no more than the practical application of facts like these that man has learned.

The other arts of civilized man rest upon precisely similar basis. The making of steel knives and of steel buildings rests upon facts learned gradually, just as agriculture was learned; facts about how to get iron from the ore, about how to purify and melt and shape it. Clothing, houses, tools and weapons, the modern profusion

on to their successors. Men die. The corporation does not.

Civilization began and has continued because society, embodied in the tribe, the nation, the group of states or nations, has worked just as a corporation does. Imagine, for instance, a primitive man who has become unusually expert in that greatest and most important of prehistoric

WHAT? NEXT?

1923

and the permanence of this cooperation through more than one generation. The invention of this system, not the invention of fire or of agriculture or of metals or of any other material thing, is what we must call the invention of civilization.

The men who invented this kind of cooperation were, so far as we can determine, the men of the age that scientists call the Neolithic—the Age of New Stone.

At the end of the last chapter we saw how the men of this New Stone Age were beginning to come into Europe 10,000 or 12,000 years ago as wanderers out of Asia. Men of the same sort had already founded, as we shall see presently, the ancient civilizations of Egypt and of Babylon. Other waves of these same men had moved eastward instead of westward and were to found, a little later, the ancient civilization of China.

Fathers of the Modern World

It is probable, even, that some of these same New Stone Men crossed the Pacific by way of Siberia and Alaska and that their descendants, centuries later, produced the ancient American civilizations of the Mayas and of Peru. There is little doubt that when we come to know better what went on in the thousands of years before written history began, we shall be able to trace the beginnings of every known civilization, past and present, to these same men of the New Stone Age.

This is a very significant fact. The reason for it is that these New Stone Men, in the thousands of years before they moved into Europe, had invented cooperation. They knew how to work together. The New Stone arrow-maker taught his skill to boys and left it behind him for the progress of mankind. The tribal communities of the New Stone Age were continuous communities, like corporations. Nothing useful was lost.

The artist-hunters of the Old Stone Age who had held Europe for so long before the New Stone men arrived, do not seem to have known anything about this great invention of the cooperative community. That is why they never invented any real civilization.

In these earlier Old Stone times, 15,000 or 20,000 years ago, Europe was in the last stages of the Great Ice Age. It was a coun-

MIDDLE AGES
1300 A.D.

arts, the making of good knives and arrow-heads out of stone. This art required both great knowledge and great skill of hand; knowledge of just what kind of stone to use and of how to chip it into shape, skill in applying exactly the proper pressure at exactly the right point in order to flake off just enough of the stone and not too much of it.

A man skilful at this was a great asset to any tribe or family in the prehistoric world. As long as he was alive, the tribe had better weapons than their neighbors. But suppose he died?

Men discovered, after a while, that such skill should not be allowed to die with its possessor. So they invented the idea of apprenticeship. A promising boy was assigned to help the skilled stoneworker. Gradually the boy acquired some of the skill and knowledge of the older man. In time the old man died, but there was no loss to the tribe. His skill went on in the person of his youthful pupil.

Cooperation the Key to Civilization

This same sequence of events applied to other arts, and applied generally to everything in life, will give you the clue to the cause and essence of civilization. It requires, you notice, that men should live more or less permanently together, that the children should be kept permanently with the tribe or family group, not kicked out as soon as they are old enough to shift for themselves.

That is what civilization really is: the cooperation between a fair number of men

ROME 50 A.D.

f machines, all depend entirely upon this same process of the slow accumulation of knowledge. That is what civilization is.

It is important to remember, however, that the cause of civilization is not the mere possession of agriculture or fire or metals or machines. It is not even what we call discovery or invention. The real cause of it, the cause of all the progress that the world has managed to accomplish, is quite a different thing. It is the fact that discoveries and inventions have been remembered.

This remembering of things is a racial matter, a cooperative matter. One man, left by himself, could never have produced a civilization. Even if he had succeeded, by some miracle, in producing it, it would have perished when he died. The progress of the world has gone on because men have worked together as members of the larger whole that we call mankind. Men working singly, as individuals, would have accomplished nothing.

Think, for example, of a great modern corporation. The policy of such a corporation, the ideals of its founders, its processes and secrets, its accumulated knowledge of materials and markets and trade movements, may go on for generations. That one set of its officers learns is passed



try of chilly, treeless plains a good deal like Siberia or northern Canada today. Herds of reindeer and of wild ponies wandered over the plains. The Old Stone men lived on these herds. The bodies of the animals supplied food and their skins supplied clothing. The men of the Old Stone Age depended on the herds of ponies and of reindeer much as the Indians of the Western plains depended, centuries later, on the herds of buffalo.

A life like this did not encourage cooperation or the formation of communities. It was a roaming life. The herds of animals were always moving and man had to stick close to them or he would starve. A whole tribe would scare the herd away or exterminate it. It was better that no more than two or three people should live together.

The Old Stone Men Overcome

This age of scattered hunters, hanging, two or three together, on the flanks of the grazing herds, lasted in Europe for perhaps 10,000 or 12,000 or more years. Its most flourishing times, the times of the best cave paintings and the skillful making of stone tools, was about 16,000 years ago. At the same time the New Stone men who were to supplant them were developing cooperation elsewhere, perhaps in Asia.

And then, gradually, there came a change. The Great Ice Age was ending. Europe was growing warmer. Forests began to spring up on the grasslands, and the herds, which could not graze on forest lands, grew sparser and moved north where the country was still too cold for trees. The Old Stone men who had lived so long and safely on the produce of the herds faced the ruin of their world, just as the Indians, long afterward, were to face extinction when the introduction of firearms began to exterminate the buffalo.

This was about 12,000 years ago, and it was then that the men of the New Stone Age began to come from Asia.

They came into a population already weakened by the loss of their traditional food supply, a population that already had been forced to change, as their tools and weapons show, from a race of hunters into a people who eked out a bare existence by spearing fish in the streams.

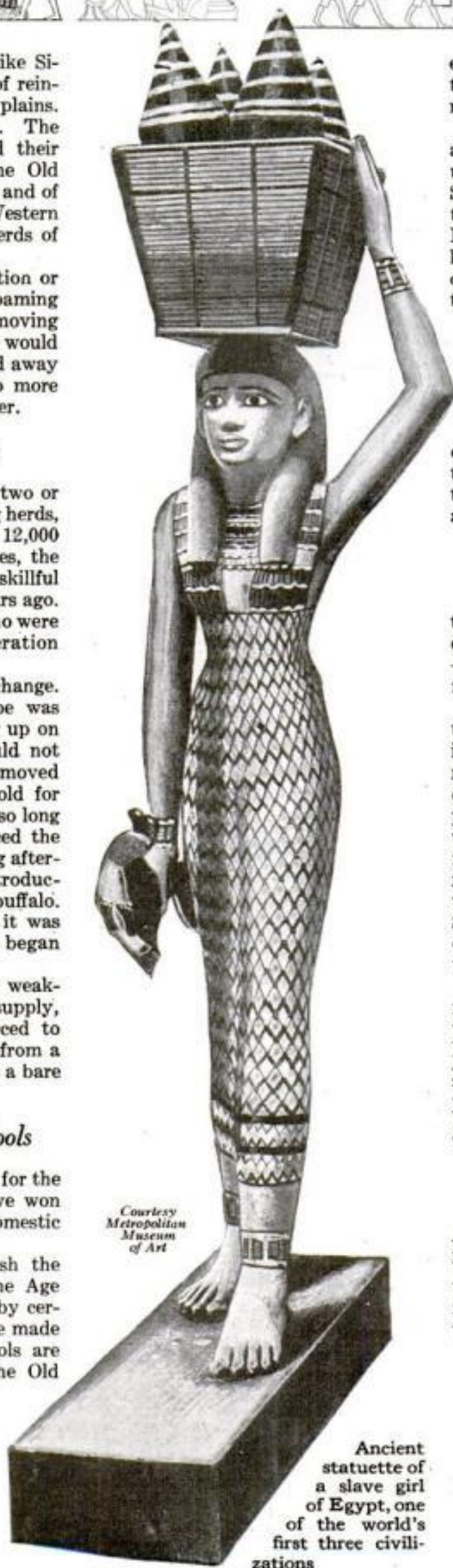
New Stone Men Used Better Tools

This may have made the conquest easier for the New Stone invaders, but they would have won anyway. They had agriculture and domestic animals and better kinds of tools.

Scientists are accustomed to distinguish the remains of these two contrasted ages—the Age of Old Stone and the Age of New Stone—by certain differences in the stone tools that were made in the two periods. The New Stone tools are smoothed and polished. The tools of the Old Stone men are merely chipped, though many of them have efficient shapes and razor-like edges.

From the viewpoint of an historian of civilization, this difference in the tools is not the important difference. The important one is that the New Stone men used pots made of baked clay, the same kind of pots that were made by the Indians of the American Southwest until a few years ago.

This fact—the beginning of the use of pottery—is probably the most important landmark in human history. If we knew in just what year men first used pots to cook in, we



Courtesy
Metropolitan
Museum
of Art

Ancient
statuette of
a slave girl
of Egypt, one
of the world's
first three civili-
zations

It marked the end of Man the Cunning Animal; the beginning of Man the Master of the World.

This was not, of course, because of any magic virtue in the mere possession of a

evidence. It is important because it proves that man had invented cooperation and communities, that he had begun to have a home.

Why does pottery prove this? Because pots are breakable. A wandering population has no use for them. The homeless hunters of the Old Stone Age would have smashed pots faster than they could make them. When we find that the New Stone Men had pots and plenty of them, we know that their wandering days were already over, that they had made the first great invention of the beginning of civilization, the invention of a permanent home in which a number of people could live together and begin the cooperative accumulation of knowledge.

The first pots are found among the relics of the New Stone Age. There we find also the first evidence of agriculture, the first use of domestic animals (except, doubtfully, the hunting dog), the first weaving of textiles, the first indications of huts or houses of any kind.

New Stone Traces in Persia

This is why we feel so sure that we must credit to these New Stone people the making of that original invention that made all others possible—the invention of cooperation and of community life.

The earliest remains of this New Stone Age that was to prove such an important landmark in human history have been found, not in Europe, but underneath the ruins of the ancient city of Susa in what is now the southwestern part of Persia. One hundred and thirty feet under the surface of the rubbish heaps that mark the ruins of this city, modern diggers found the relics of the New Stone Men. Under this was virgin soil. The people of the New Stone Age were evidently the first inhabitants of the site of Susa and investigators believe that they settled there more than 8,000 years ago.

This is much earlier, you notice, than any remains of the New Stone Age in Europe. At that time the men of the Old Stone Age in Europe had not begun to decline. In fact, they had not yet reached their best and most artistic age. At least 6000 years were to pass before people like those who settled in Susa were to appear in Italy or France.

Human Progress Flourishes in Asia

This makes it evident that the clock of human progress ran faster in Asia than elsewhere in the world. The great invention of the community, the discovery of agriculture, the taming of domestic animals, the production of pottery, all were accomplished somewhere in Asia, perhaps in the neighborhood of Susa itself, 6000 or 8000 years before Europe experienced them at all. When these essentials of civilization came into Europe, they were brought by invaders from the east.

These invaders must not be thought of as a marching army nor as of any single race. They seeped into Europe gradually. They permeated rather than conquered it.

What happened must have been a great deal like the situation of 70 or 80 years ago in the American West, when the farmers were beginning to push out there. The only white men who were already in this western country were hunters and trappers. Most of them were solitary men. They moved around to follow the game. They attempted no agriculture. They had almost as few

possessions as their ancient European prototypes, the men of the Old Stone Age.

Then the farmers began to come into the country. They were of no different race from the trappers who were already there, but they had a different outlook on life. They were men with homes. They brought their oxen and their plows. Their wives and children rode with them across the plains in long trains of covered wagons. These men were "settlers." They meant to settle down in one place and stay there, just as their European brothers of the New Stone Age had done so many centuries before. Gradually they pushed the wandering hunters altogether out of the country.

The Difference in Knowledge

In just about this way, we may imagine, the New Stone men supplanted the Old Stone men in Europe. They were not conquerors or invaders in the military sense. They were not aliens. The men of both periods were of mixed races and apparently of the same races, just as the American emigrants, hunters and farmers alike, were mixed and were similar.

The difference in favor of the New Stone men was a difference in knowledge. They had begun to accumulate a stock of common knowledge. They possessed the essentials of civilization. The Old Stone men did not.

But meanwhile, on their way to Europe, some of the New Stone emigrants had stopped off and started communities, much as some of the westward settlers of the forties stopped off at Kansas City or at Omaha and founded cities of their own. One group had entered the fertile valley of the Nile. Another group had settled in the plains of Babylonia. A third group had discovered the island of Crete in the Mediterranean Sea.

All three of these groups developed local centers of civilization. By 4000 or 4500 B.C., there were kings and governments and writing and the beginnings of science in both Egypt and Babylonia and the development of Crete was not more than 500 or 600 years behind.

The Oldest Race?

And here is the important point: Underneath the ruins of all three of these ancient civilizations, at the very bottom of the scores of feet of rubbish accumulated during the 6000 years of recorded history, we find the flint knives and the broken pottery of the New Stone Age.

The men who founded Susa were men of the same habits and culture as those who founded Crete and Babylon and Egypt. They were, indeed, the men who founded everything. They brought into these ancient lands the seeds of progress

and of greatness just as surely as they brought into Europe, when they reached it, the seeds of barley and of wheat.

These men of the New Stone Age, not the Greeks nor the Romans nor the Nordics, were the real founders of the modern world.

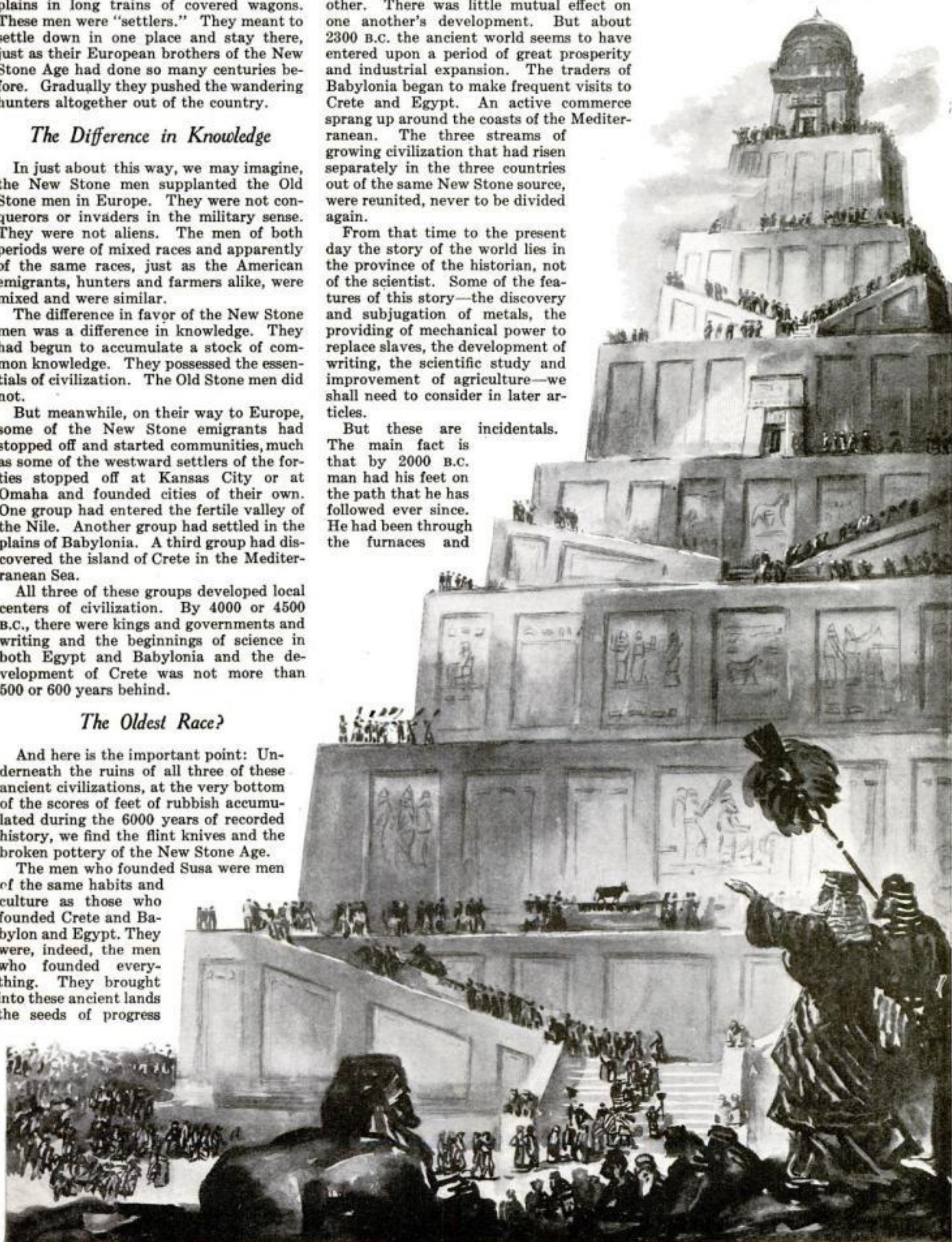
In the beginning, the three ancient civilizations of Egypt, Crete, and Babylon were not importantly in contact with one another. There was little mutual effect on one another's development. But about 2300 B.C. the ancient world seems to have entered upon a period of great prosperity and industrial expansion. The traders of Babylonia began to make frequent visits to Crete and Egypt. An active commerce sprang up around the coasts of the Mediterranean. The three streams of growing civilization that had risen separately in the three countries out of the same New Stone source, were reunited, never to be divided again.

From that time to the present day the story of the world lies in the province of the historian, not of the scientist. Some of the features of this story—the discovery and subjugation of metals, the providing of mechanical power to replace slaves, the development of writing, the scientific study and improvement of agriculture—we shall need to consider in later articles.

But these are incidentals. The main fact is that by 2000 B.C. man had his feet on the path that he has followed ever since. He had been through the furnaces and

forges of his animal ancestry and his body was as perfect as it is today; as perfect, probably, as it ever will be. His mind had taken on its present mold. He had learned how to cooperate with his fellow men, and he had invented communities and homes.

Man was ready in those ancient days, 40 centuries ago, to begin his greatest adventure.
(Turn to page 96)



Largest Oil Tank Covers 20 Acres



Bird's-eye view of the world's largest oil tank at Wilmington, Calif. The capacity of the tank is 1,750,000 barrels of oil

COVERING an area of 20 acres and with a capacity of 1,750,000 barrels, the world's largest oil storage tank is nearing completion at Wilmington, Calif. The concrete tank will rise only eight feet above the ground, half of it being below the surface. The roof will be supported by wooden poles set in concrete blocks in the bottom of the tank, also of concrete.

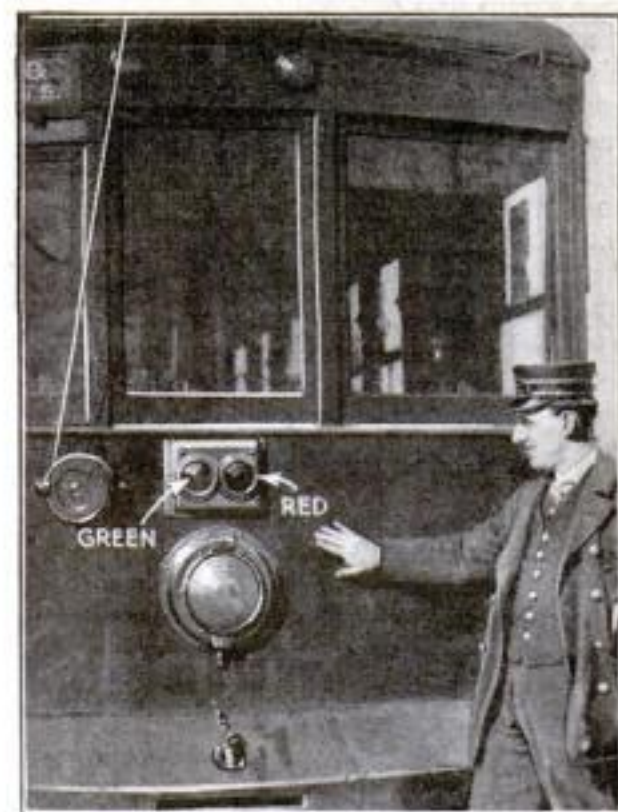
Despite the vast quantity of oil that will be held in the tank, the sides and bottom will be only four inches thick. This feature is made possible by the careful preparation of the earth under the tank, by the methods of reinforcing the concrete and by the nature

of the concrete. All soil around the excavation for the tank within accurately determined distances is removed and repacked until it is much more dense than at first. This is accomplished by tractors treaded with iron attachments that resemble a sheep's hoof. The sides of the excavation are packed beyond the limits to which the side of the tank will extend. These sides are then cut through so that at all places the texture of the soil will be constant.

This mammoth tank is the only large concrete project of its kind built of poured concrete; usually they are constructed of steel.

Stop and Go Signal Lights for Trolley Cars

THE latest in "go-go" signals is now being operated on trolley cars in Baltimore. The signal consists of two lights, red and green, which indicate when



How signals are placed on cars

the car is stopping or starting and when it is slowing down.

When the car is under way, the green light burns; when it is slowing down, the red and green show; and when it stops, the red alone shows.

Filament Prevents Dust Explosions

SEEKING to eliminate dangerous dust explosions in mines, flour mills, and other industrial plants, scientists recently have succeeded in developing a device that promises to do away with much of the hazard when the atmosphere becomes permeated with finely divided particles of highly combustible dust.

The device, called an "atonator," is simply an exposed electric



Testing the atonator in a laboratory

light filament covered with porcelain. The glowing porcelain, heated by the filament, burns up gases and inflammable dust so fast that they cannot accumulate to cause explosions.

Pull the Ribbon and up Comes Your Card

A HANDY little cardcase that keeps the cards clean and gives them up at the pull of a ribbon, has been invented recently by a Chicago firm. It lies flat in the pocket, has no metal parts, flaps, or buttons, and is made of flexible leather.

A ribbon fastened at the back runs under the cards and comes out at front near the top. When a card is wanted just pull the ribbon. The cards come up. When pushed down, the ribbon runs back in its slot, leaving only the end sticking out, as illustrated above.



Birds Have Powder Puffs

HUMAN beings have no monopoly on toilet accessories.

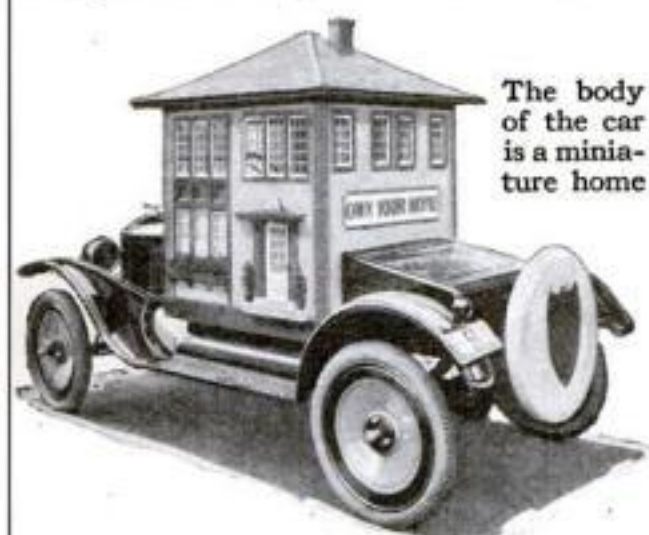
The barn owl, among other birds, has a comb concealed on the inner edge of one of its claws. The English pigeon and the hawk each have a powder puff. The powder is made by certain small feathers that become brittle and crumble into a fine white powder, which the birds use to gloss their feathers.

Novel House on Wheels Boosts Home Owning

TO PROMOTE an "Own Your Own Home" campaign, an Omaha lumber company is using a novel automobile that is really a model house on wheels.

The body of the car is a reproduction of an old English type house decked with flower boxes holding evergreen shrub plants. An electric light attached to the lighting system of the car illuminates the doorway.

The house is complete in every detail, even though constructed on a miniature scale.



The body of the car is a miniature home

New Glass Letterbox Shows Contents at Glance



ONE glance at a newly invented glass mailbox tells whether the postman has delivered a billet doux or a bill.

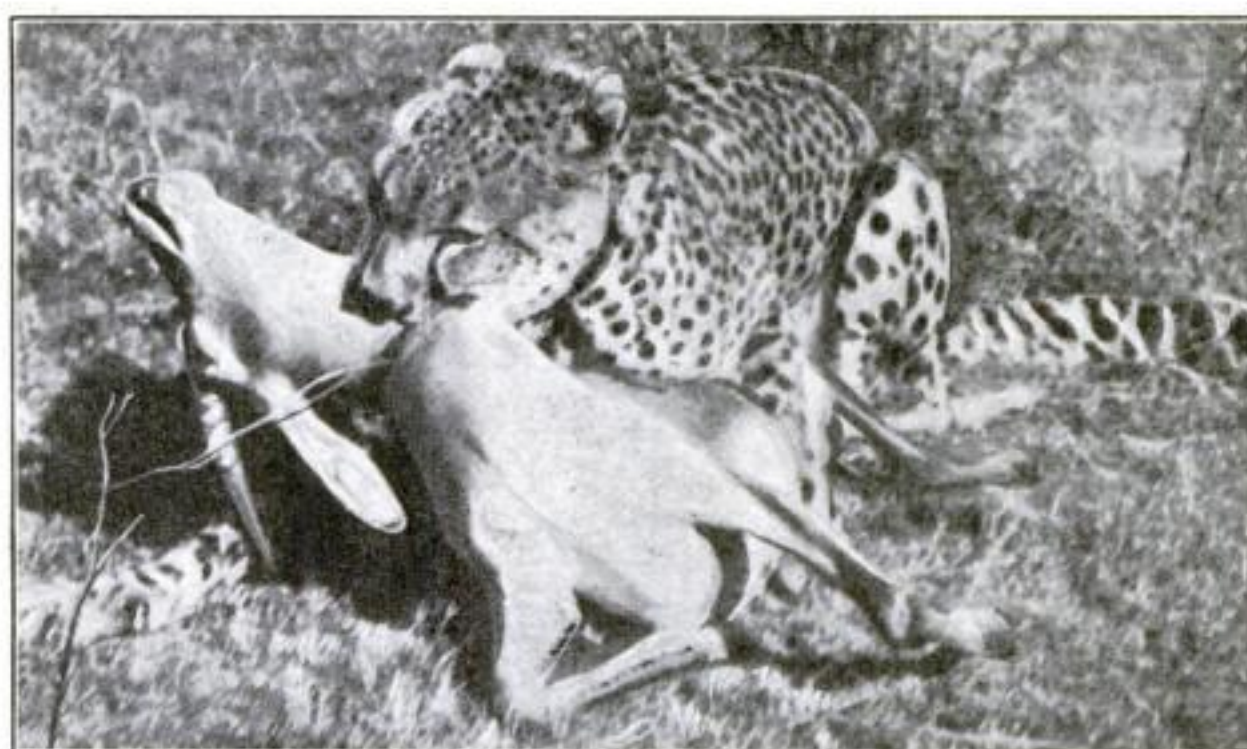
The glass is hard enough to withstand considerable pressure. A strong lock protects letters from theft. Screw holes are so placed that the box cannot be removed when the lid is closed.

Watertight Rowboat Built in Two Sections

A ROWBOAT built in two watertight sections that can be collapsed, to facilitate transportation or storage, has been invented by Adan E. Olson of Holton, Mich. The sections are divided so that one section will fit into the other. They are connected by means of a detachable hinge and pin arrangement so that the boat can be assembled or taken down without tools.



The bow section



Hunting Deer with Trained Leopards

ONE of the world's most spectacular and thrilling sports is that of hunting with cheetahs, or trained leopards, in India. The animals are trained to stalk, kill, and surrender their game to the hunters without mutilating it. The remarkable photograph above shows a cheetah retrieving a deer during a hunt in Baroda State, India.

Cheetah hunting was first developed by Husing, King of Persia, in 865 B. C. Certain of the Mongol kings were wont to go on cheetah hunts, using as many as a thousand leopards.

The cheetah is a beautiful, powerful animal, reddish yellow in color and marked with coal-black spots. In confinement the

animal often attains the faithfulness usually ascribed to dogs, being extremely tame and fond of its keepers.

Hooded and chained like a falcon, the cheetah is conveyed to the scene of the hunt in a low car without sides. It is possible to get within 200 yards of the game—antelopes, deer, and such animals—before they take fright. At this point the cheetah is unhooded and released. Springing from the car it slinks to the site where the game is feeding, and with huge bounds it leaps into their midst and brings down one with a blow of its paw. Its share of the booty is a bowl of blood drawn off by natives.

Clams Bore Holes in Concrete Piles



Arrows point to two rock clams boring into concrete coating of pile

USE of concrete for marine construction is not so certain a solution of the marine borer problem as has been assumed, in the opinion of C. A. Kofoed and Robert C. Miller, members of the biological section of the San Francisco Bay Marine Piling Committee. This belief is based on recent investigation of the damage done to concrete-coated piles in Los Angeles harbor by the rock clam.

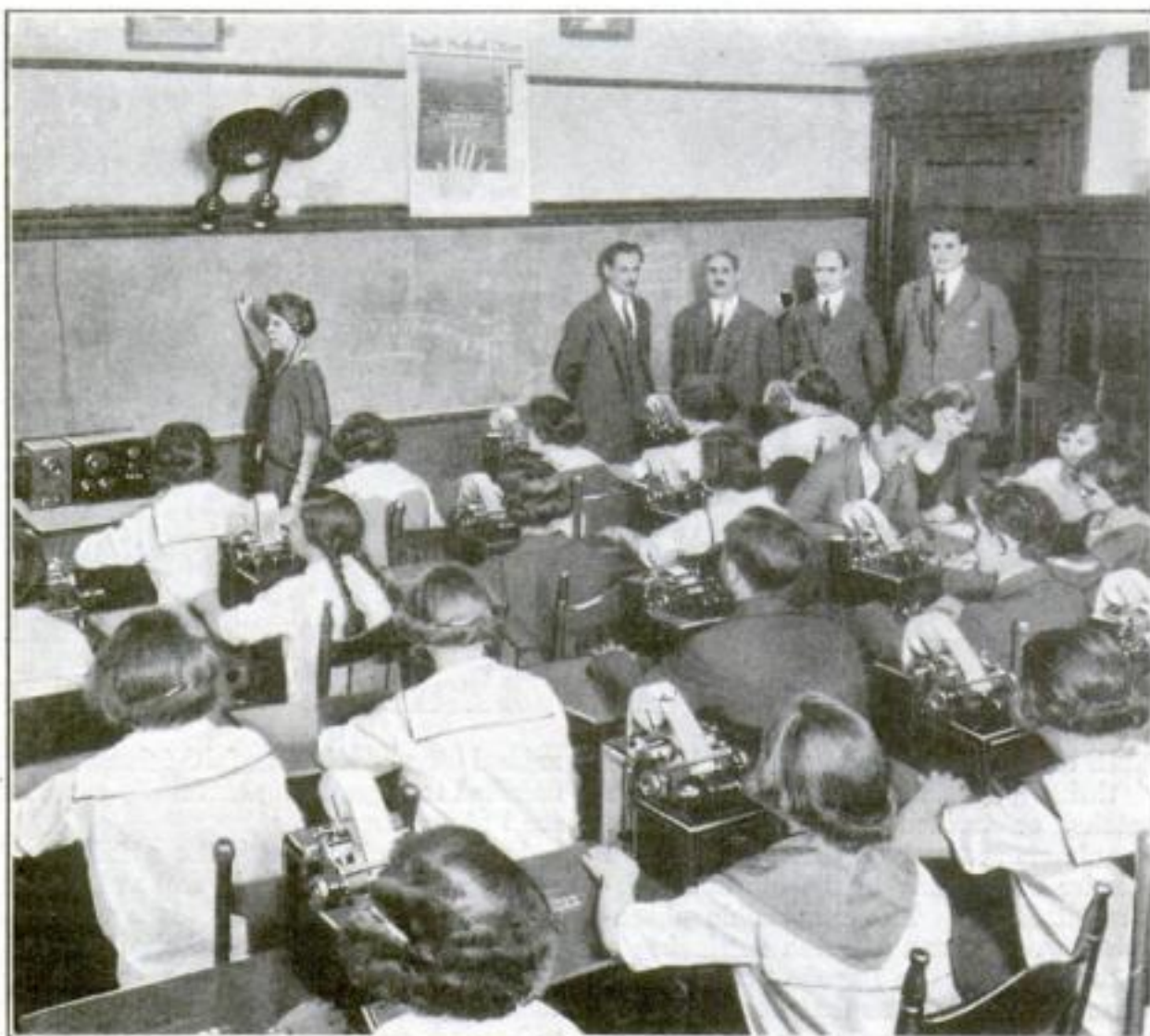
This clam has attacked about half the concrete piles in the harbor. About one fifth of this number were badly bored.

The rock clam works only in hard material. When the wood is reached, inside the concrete, the clam stops boring. The holes left, however, give access to the wood borers.

Just what pile protection will be devised is problematical now. If, as it is now believed, the boring of the rock clam is a chemical instead of a mechanical process, the concrete will not be able to withstand its attacks, no matter how hard the material is constructed.

The problem presented by this discovery is now being closely studied by engineers.

High School Class Taught by Radio



OFFICIALS of the New York City Board of Education and principals of more than 25 city high schools recently witnessed the first successful demonstration of radio for instruction in high school classrooms. At its conclusion they were convinced that eventually radio will offer to thousands of pupils in widely separate localities the advantage of listening to leading instructors and experts with whom otherwise they never would come in contact.

In the demonstration, accountancy was chosen as the subject offering the most conclusive test of this new force in spread-

ing education. From broadcasting station WJZ in Newark, N. J., a series of accountancy problems were broadcast. These problems were received at Haarlem High School in New York, where there had been installed a receiver and loudspeaker equipment. Here the students were seated at their adding machines.

Each problem came slowly and distinctly. A few minutes after the lecture was completed, the correct answers were broadcast and received. Then they were checked with the students' results. The general correctness of the classroom work was testimony of the clearness with which radio waves carried.

Radio Brings Hearing to Deaf Boy

ONE of the scientific miracles of the day is that many deaf persons are enabled to hear by means of radio.

Leo Kuehn, of Detroit, Mich., recently heard for the first time in his life when a doctor placed a pair of radio receivers on his ears.

Most deaf persons can hear better over a telephone because of the concentration and amplification of sound in the receiver. When the sound is louder, the sound waves strike the eardrum harder and cause even a rigid drum to vibrate.

In radio instruments, where sound can be amplified almost indefinitely, the possibility of starting the necessary vibrations through loudness of sound is intensified.

Schools for the deaf throughout the country are now making experiments with special radio devices.

IN NEXT month's issue—The first of a series of articles dealing with the development and operation of various modern circuits, by Jack Binns, our Radio Editor.

Valuable facts about the standard single-circuit set, the Flewellyn circuit and the Armstrong single-tube super-regenerative circuit—in the August issue.



Leo Kuehn, of Detroit, Mich., who heard for the first time by radio

Ingenious Pocket Phone Needs No Antennae

TO the list of novel and ingenious radio appliances is added the invention, by Tracy Hicks of Kansas City, Mo., of a wireless pocket phone requiring little if any antennae and only a ground wire.

The set has a phone at one end of a tube in which is contained the crystal detector and a tuning coil. This tuning coil is set to receive messages in certain wave lengths and the crystal is permanently set.

If sufficiently close to the station, the coil acts as an aerial and only a ground is needed. At greater distances, house wiring circuits or other metallic lines will serve as a ground.



Smallest Aerial Brings in Long Distance Concerts



KENNETH HARKNESS, chief engineer of the New York Radio Guild, is shown above tuning in with a tiny aerial recently designed by him. The aerial is so sensitive that it picks up broadcast concerts on its three-inch coil of wire.

Eighty-five feet of wire, spider-web wound, is used in the construction of the coil aerial. Concerts broadcast from Schenectady, N. Y., have been plainly heard in New York City, a distance of 150 miles, over this set.

Aurora and Thunderstorms Affect Messages

THAT thunderstorms and the aurora borealis affect the audibility of radio messages has been definitely established in recent experiments by the Weather Bureau of the United States Department of Agriculture and by the reports of northern radio stations. Atmospheric conditions seem to have no effect except as they affect the electrical condition of the air. The barometric pressures at either the sending or receiving stations also have no effect on the audibility.

Silencing Shrieks and Groans in Sensitive Radio Sets

Our Radio Editor Announces Important New Inventions

By Jack Binns

THE world of radio is astir with the most important divorce case in its brief but spectacular existence. It is the divorce of radio frequency amplification from radio regeneration.

And the outcome of the separation, brought with great possibilities for the future of wireless, is to silence the shrieks, groans, and whistles of regeneration that have marred the enjoyment of supersensitive receiving sets. No longer will choruses of chirping birdies pipe in on grand opera, or emerge with the Sunday sermon from the radio frequency receiver.

This transformation has come about through the efforts of Prof. L. A. Hazeltine of the Stevens Institute of Technology, one of the foremost radio experts of the country. He has succeeded in doing what other experts almost had despaired of doing. He has invented a new system of amplification that bids fair to draw a complete dividing line between radio frequency amplification and regeneration.

This invention, involving the principle of tuned radio frequency, opens up untold possibilities for the development of supersensitive sets. It is revolutionary for the following reasons:

First, it permits a step up ratio in the interstage transformers; second, it achieves amplification without a trace of regeneration; third, it permits the use of any type of hard vacuum tube, irrespective of individual characteristics; and, finally, it provides what all investigators have long sought—a receiver that is incapable of radiating energy. Thus it removes from future radio development a troublesome source of interference.

How the New System Works

The new system, called the neutrodyne, is based upon capacity neutralization. That term sounds very terrifying; really it is very simple. For example, take two conductors of electricity. If they are placed close together in a parallel position, separated by a non-conductor, they immediately act as a condenser. In other words, they are susceptible to an electrostatic charge, the capacity of which will depend upon the area of the conductors and the nature of the non-conductor between them.

Now assuming the position of two con-

ductors as outlined above, it naturally follows that the grid and plate elements inside a vacuum tube form a condenser. This condenser, although of very small capacity, is nevertheless really important in its effect, because it provides an electrostatic coupling between the grid and plate circuits of the radio receiver, and so produces a feed-back action.

operation—the balancing of two forces of equal value against each other so that they neutralize and so eliminate the effect that either one alone would cause.

The neutrodyne receiver accomplishes this balancing and neutralizing by means of condensers. In other words, Professor Hazeltine has destroyed capacity feed back action in radio frequency amplifying cir-

cuits by the process of opposing the condenser that exists in the vacuum tube with another condenser of exactly the same capacity. As a result, the tubes, while in operation, cannot possibly get into an oscillating state and the circuit in which they are being used cannot heterodyne upon the incoming carrier wave to cause the regenerative whistle. In addition, it is impossible for the tubes to feed back energy to the aerial circuit, therefore the receiver in which the system is employed cannot radiate energy from the aerial to annoy other listeners.

Through the employment of this system it has been possible to obtain a step up ratio of four to one in the interstage transformers. But since the tuned system of radio amplification is used, these transformers are of entirely

different construction to the types now in general use.

It is in the novel construction of the neutralizing condensers, however, that the main interest of the new system lies. These are the smallest variable condensers ever made, yet they are the acme of simplicity. They consist of two wires around which an insulating material is wrapped, the two wires being separated from each other. They are inclosed by a metal cylinder just large enough to slide over them.

Is Equivalent to Two Condensers

This arrangement is equivalent to placing two condensers in series. Since it is a fact that when two condensers of equal capacity are placed in series with each other the resulting capacity in the circuit is only one half that of either of them, it will be seen how small the total capacity of this little condenser really is. Condensers of this type have already been made as low as .000001 microfarad, or one millionth of a millionth of a farad.

The manner in which the condenser is adjusted to neutralize the capacity of the tube is another novel feature. When the receiver has been turned on in the usual way it is tuned to a very strong



The new "neutrodyne" squealless radio receiver and its inventor, Prof. Louis A. Hazeltine, of the Stevens Institute of Technology, at the left. This receiver uses two stages of tuned radio frequency, detector, and two stages of audio frequency amplification. It will work without any aerial or ground

This feed-back action becomes more pronounced the lower we go in the scale of wave lengths. The reason for this is found in the fundamental principle that the shorter the wave length the higher will be the frequency of the current involved, and high frequency alternating current finds an easy pathway through a condenser. This is the factor that has delayed the development of radio frequency amplification on short waves. Even now it remains a problem, because of the tendency of the circuit to enter into an oscillating condition through the feed-back action in the tubes of the radio frequency stages, hampering clear reception. The oscillations of radio frequency circuits have been kept subdued to a certain extent by means of potentiometer control, but to accomplish this a great deal depends on the transformers and general construction of the set.

Professor Hazeltine has attacked the problem presented by electrostatic or capacity coupling in an entirely novel manner, with the result that his new receiving set is absolutely quiet in operation, and remarkably free from distortion of sounds. It seems to be the ideal set of the future.

The principle involved is one that figures largely in all kinds of electrical

signal coming from a transmitter in the laboratory. The filament of the first tube is then turned off, but the capacity coupling tube is sufficient to pass the signal through the rest of the receiver. The neutralizing condenser then is put in the circuit and adjusted until the signal disappears entirely, which is at the point where the capacity matches that of the tube. Since these adjustments are made with the filament cold, regeneration is impossible, for no electronic stream flows from the filament.

While the new system is extremely easy to operate, it is not a circuit for the radio fan to build—at least not yet. It requires specially made and adjusted neutralizing condensers to fit the capacity of whatever type of tube is used with it. To work effectively these condensers must be constructed where there are good manufacturing and laboratory facilities.

But the invention does offer wonderful possibilities for the future. Reducing the interstage tuning to one control apparently removes all limits to the number of radio frequency amplifying stages that can be used in a set embodying the new principle. Remarkable results have already been obtained from the receiver. It has demonstrated that it can take its place with the best developed of the supersensitive receiving sets.

The New Dry Cell Vacuum Tubes

THE advent of new and improved dry cell vacuum tubes has taken away from ordinary radio frequency amplification one of its chief drawbacks—the storage battery. It is now possible to construct a six-tube set using dry cell tubes throughout.

There are some precautions, however, to be observed in using the new tubes, in order to get the best possible results. First,

since they are hard tubes, they should have from 40 to 45 volts in their plate circuits when they are used as detectors.

In using them as audio frequency amplifiers, 100 volts can be placed on the plate circuits in order to get sufficient volume to

may be necessary to employ a resistance in the loop circuit, as shown in the accompanying diagram, in order to quench the oscillations. This is not recommended as general practice.

Another method of keeping down oscillations in the radio frequency stages is to reduce the plate voltage. This may tend to reduce the range of the receiver but much more stable reception will be obtained. If the plate voltage is reduced without the use of a potentiometer in the circuit it is very important to observe the following arrangement of the grid circuits.

The grid circuit is from the grid through the secondary of the radio frequency transformer to the filament. In the first stage, of course, the return is through the loop to the filament.

Arrangement of Circuits

First, the rheostat controlling the tubes should be in the negative side of the A battery lead as shown in the diagram. Second, that part of the grid circuit which is connected with the filament should be placed on the A battery side of the rheostat, and not between the rheostat and tube. This arrangement puts the necessary negative bias on the grids of the amplifying tubes. The exception to this is in the case of the detector tube where a grid leak and condenser are used. Here the grid circuit must be connected with the positive side of the A battery.

Another important thing to remember in using the new tube is that it is designed to operate at full efficiency on three volts.

In circuits using three of the tubes—such as three stages of radio frequency amplification as a separate unit, or in sets employing a detector and two audio stages the problem is not a serious one. The three tubes can be joined in parallel to one battery in the usual manner, with one exception. Since their filaments will be controlled simultaneously by one rheostat only, this should have a maximum resistance of 10 ohms.

Keep a Step Ahead in Radio

THE wireless operator who flashed the world's first "SOS" distress call nearly 15 years ago is now flashing



to readers of POPULAR SCIENCE MONTHLY the FIRST NEWS of important events and inventions in radio as they occur from month to month.

Today Jack Binns, the hero of the sinking steamship "Republic," is recognized as one of America's foremost popular writers on radio. No other writer in the field of radio is so thoroughly grounded in his subject or has so broad a vision of its future possibilities.

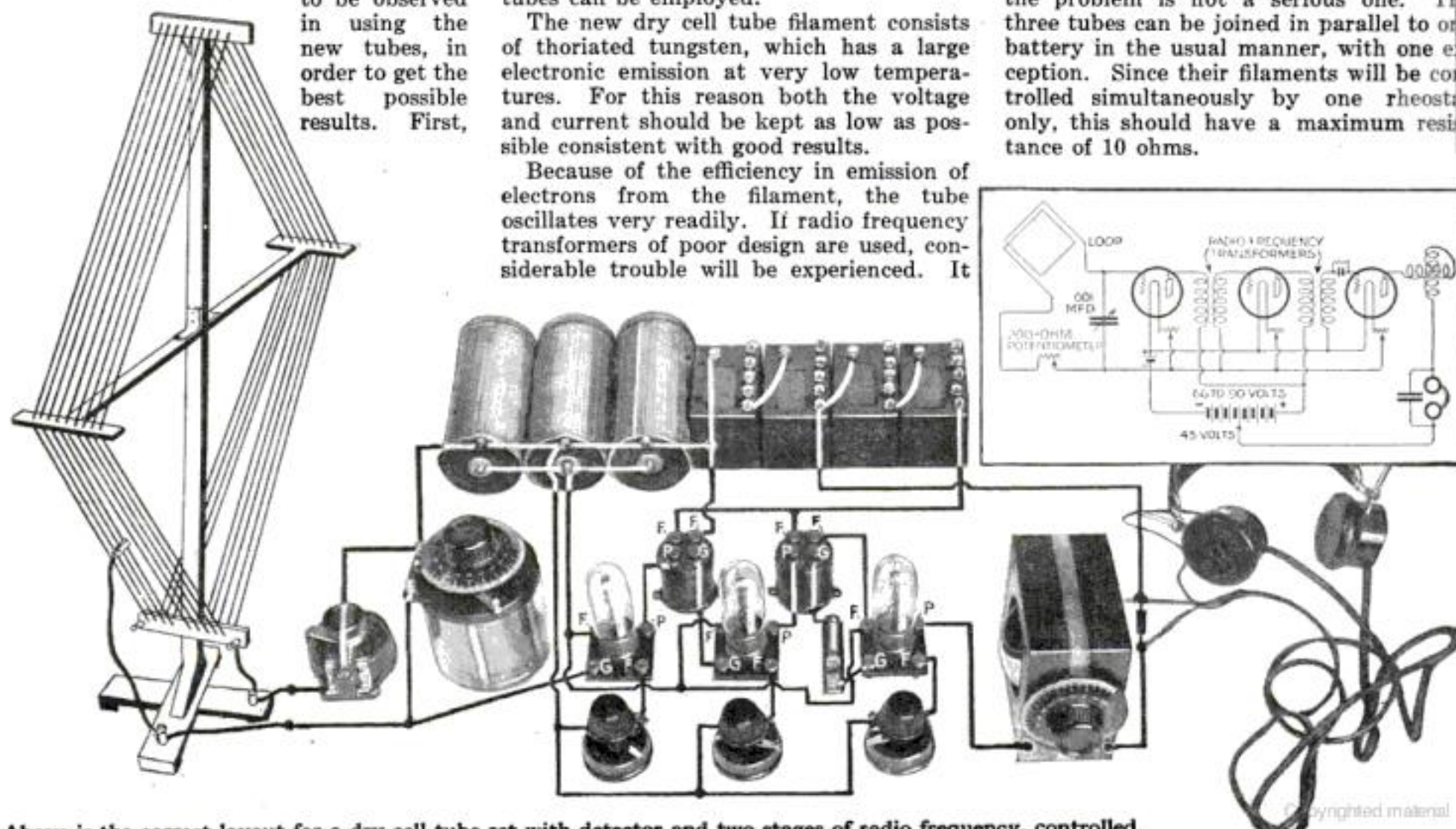
To get all the important radio news FIRST, read what Jack Binns has to say every month in POPULAR SCIENCE MONTHLY.

operate a loudspeaker, but in doing so the grids of the amplifying tubes should be kept negative with a three-volt biasing battery.

For radio frequency amplification the standard circuit with the usual potentiometer control of the grids of the amplifying tubes can be employed.

The new dry cell tube filament consists of thoriated tungsten, which has a large electronic emission at very low temperatures. For this reason both the voltage and current should be kept as low as possible consistent with good results.

Because of the efficiency in emission of electrons from the filament, the tube oscillates very readily. If radio frequency transformers of poor design are used, considerable trouble will be experienced. It



Above is the correct layout for a dry cell tube set with detector and two stages of radio frequency, controlled

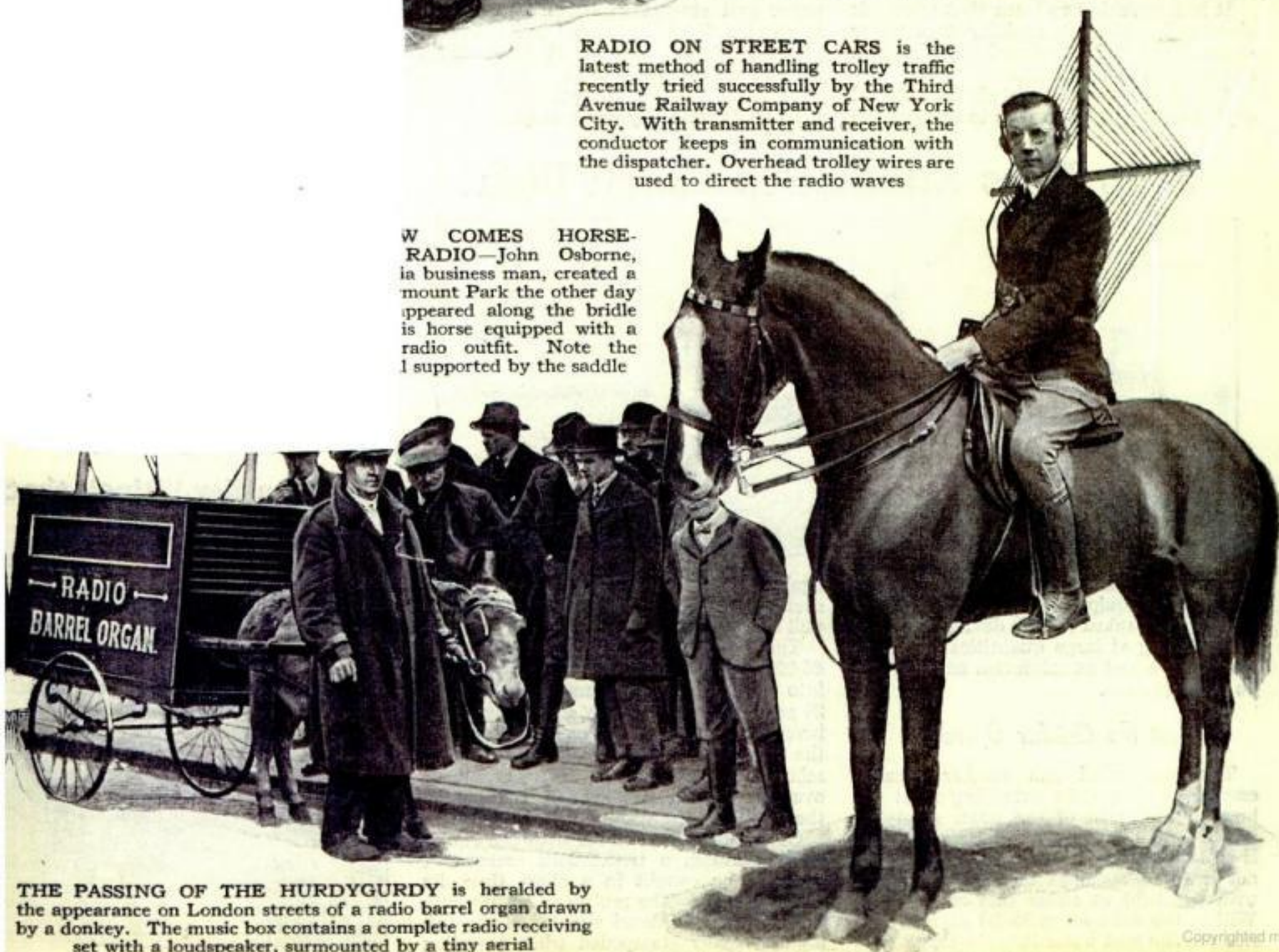
Watch Radio Grow *In Boiler Room and Streetcar; along Curb and on Horseback*

IVEN JASPER, THE JANITOR, down in the boiler room of America's first radio-equipped apartment house at Newark, N. J., can listen in on grand opera, jazz, or baseball, simply by pushing a plug into the wall. Each of the 74 tenants of the apartment house can listen to the same program in the same way. All are connected with a central radio room, equipped with a sensitive receiving set



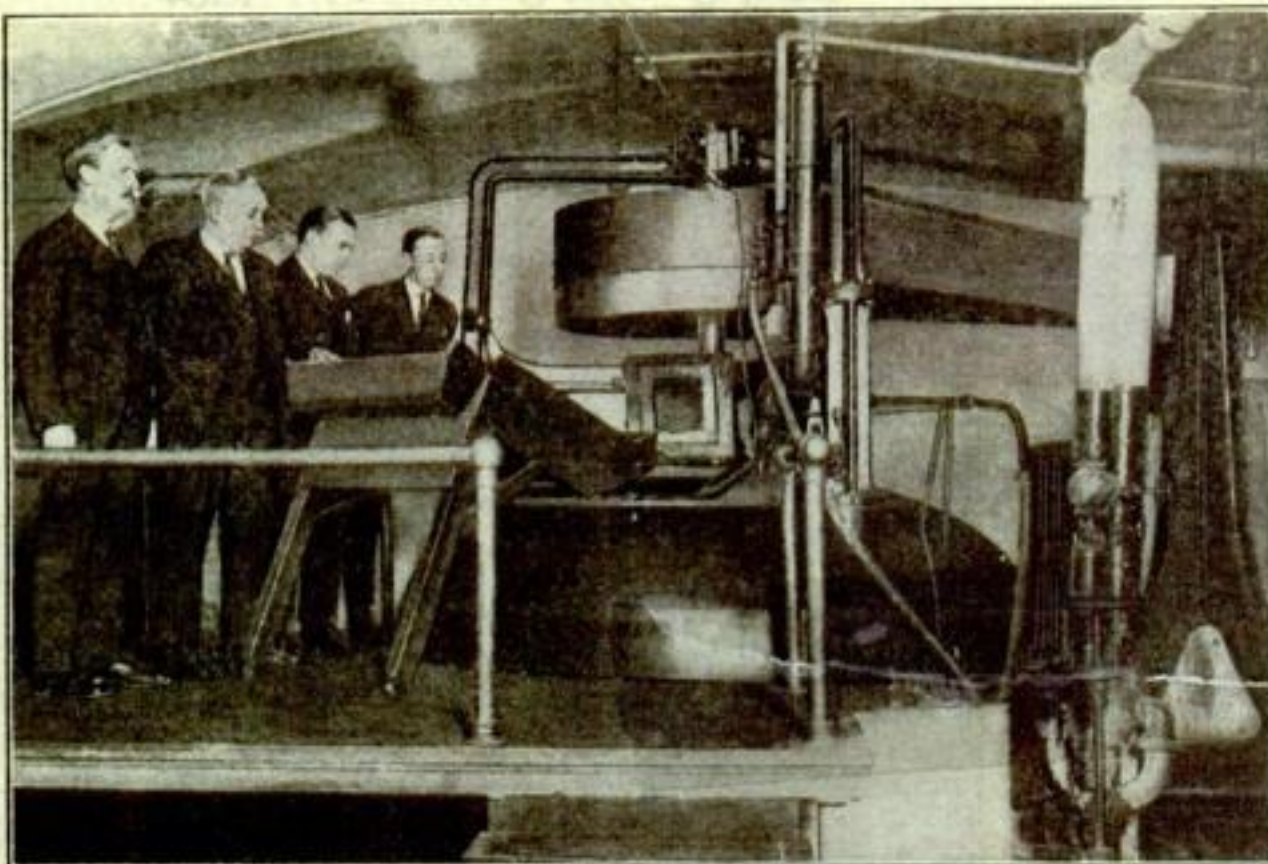
RADIO ON STREET CARS is the latest method of handling trolley traffic recently tried successfully by the Third Avenue Railway Company of New York City. With transmitter and receiver, the conductor keeps in communication with the dispatcher. Overhead trolley wires are used to direct the radio waves

W COMES HORSE-RADIO—John Osborne, a business man, created a mount Park the other day appeared along the bridge is horse equipped with a radio outfit. Note the antenna supported by the saddle



THE PASSING OF THE HURDYGRDY is heralded by the appearance on London streets of a radio barrel organ drawn by a donkey. The music box contains a complete radio receiving set with a loudspeaker, surmounted by a tiny aerial

Millions of Dollars Destroyed Daily



Members of Destruction Committee watch huge macerator destroy outworn currency in the Treasury Department, Washington, D. C. The machine is fastened with three locks, the keys of which are held only by the committee

REAch down in your pocket and pull out a dollar bill. It may look a hundred years old if it has had hard usage, or it may appear to be merely a yearling. It is neither. The life of a dollar bill averages from eight to nine months, according to estimates made in the Federal Reserve Bank.

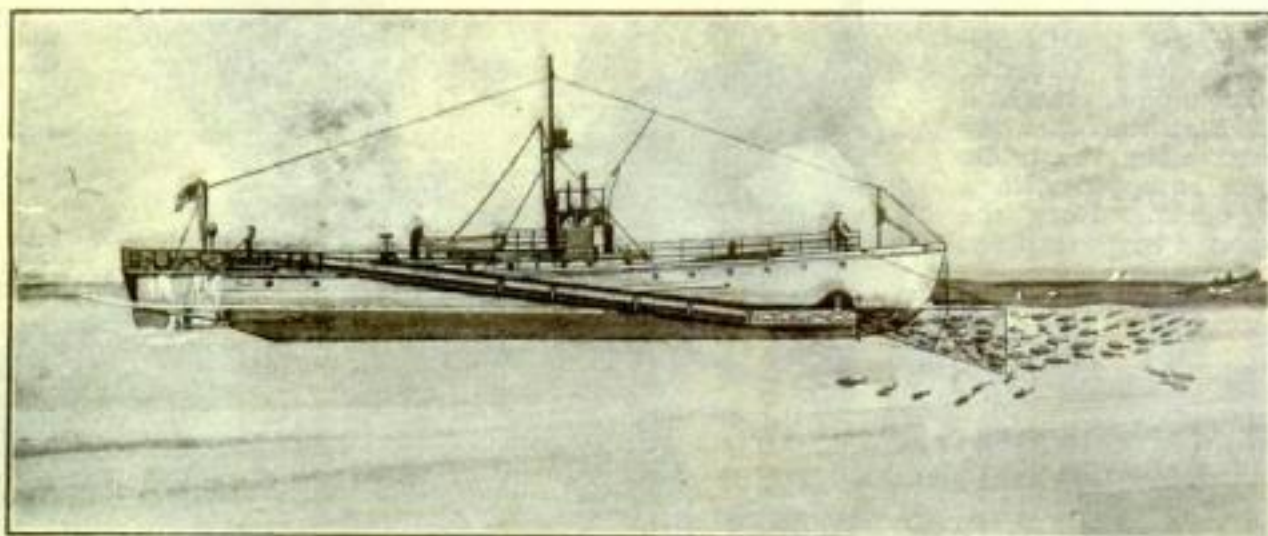
It is astonishing to learn that money is circulated with such rapidity that paper currency must be replaced after such a short period of usefulness.

A special committee exists in the national capital whose function it is to observe the

destruction of paper currency that has outlived its usefulness. Millions of dollars are tossed daily into a huge chopping machine devised for the purpose of destroying it.

A novel experiment was recently conducted in Waukegan, Ill., in which a new dollar bill was attached to a blank sheet of paper and started in circulation. After two weeks, the bill returned to its starting place, having figured in 31 transactions during that brief period. When it returned, even from such a comparatively short journey, it was dirty and crumpled.

Ship Uses Suction to Catch Fish



NOW being fitted out in New York is a ship equipped with a recently invented mechanical fishing device, whereby the catching of large quantities of fish in record time and at minimum expense can be accomplished.

How the Catcher Operates

The mechanical fish catcher consists essentially of a tube extending from the bow to the stern of the boat, emptying into a trap. An adjustable telescopic net is situated at the bow of the boat. This net leads to openings that are connected with the tube at either side of the bow. Within the tube an artificial current carries the fish and water into the trap. The

ugal pump driven by a motor, causing a suction force at the forward end that helps pull in the fish.

The equipment delivers approximately 66,000 pounds of fish and water a minute into the trap. Of this amount from 10 to 20 per cent should be fish, according to the inventors. Assuming a mean of 15 per cent, the tube will deliver 9900 pounds of fish a minute when in a school. The water flows overboard, while the fish are retained in the netting of the trap.

Going through a school with the equipment working, a tremendous amount of fish can be caught in a short time, its inventors say. The matter of getting into a school is considered simple, as the fish are not easily stampeded when traveling

Garden Hose Roller to Replace Heavy Reel

A SIMPLE metal device attached to the end of a garden hose at right angle to the natural coil has recently been put on the market as a substitute for the hose reel. Once the device clamps the end of the hose to a bend of the coil, the remainder may be rolled up, and hung on a peg.



Here's a Key "Ring" that Will Stretch

MADE up of springs, this chain permits keys to be used without detaching them from the person.

Any desired number of the spring links may form the chain. By this means the keys are fastened permanently to the owner and there is no danger of forgetting them. The chain is a recent novelty.



the Heroes of the Speedway



This magnificent panoramic view of the Los Angeles Speedway shows 15 cars lined up for the 250-mile grind in which Jimmy Murphy established a record average speed of 115.8 miles an hour. From such contests were born many improvements of the modern automobiles

The development and improvement of tires is a second striking outgrowth of the speedway. At the outset, tire trouble was the scourge of the racetrack. Public attention was called to this weakness nearly 20 years ago, when Barney Oldfield went through the fence on a Detroit track. In this instance a blowout caused the accident. Blowouts occurred frequently as long as fabric tires were used in racing. Even with the later introduction of cord tires, the increased speed of cars and the more severe conditions of the speedway tracks still caused considerable tire trouble.

The Cord Tire Proves Its Worth

In the first 500-mile race at Indianapolis in 1911, Wilcox had 13 cases of tire trouble. Drivers also suffered. Oil on the tracks caused the treads to come off in strips. The next year there were fewer cases of tire trouble at Indianapolis, and in 1913 Ralph Mulford established a record by going the full 500 miles without a tire change. He finished in the money. Tires still cause a great many stops but speed, heat, track conditions and other factors enter into the case.

As was true of the engine, commercial car makers followed the example of the racetrack. Here again the merits of cord tires as demonstrated on racing cars has resulted in their general use on passenger cars.

Another outcome of tire trouble on the track was the introduction of the demountable rim now used on nearly all automobiles. This feature was introduced first by the driver of a Renault car in the 1905 Gordon-Bennett race in France. It was the forerunner of the demountable wheel now used almost exclusively in racing and which in turn has been adopted by many manufacturers of high class cars.

Use of wire wheels, too, may be traced to the speedway. There was a scientific reason for their appearance. Besides carrying the weight of the car in suspension, and thus affording greater safety than supporting it on wooden spokes under compression, the wire spokes aided in radiating the heat from tire friction. Wood, a non-conductor of heat, kept the tires hot, while wire helped to carry the heat away.

Lack of stability in the wooden wheel was strikingly demonstrated in the Indianapolis race of 1912, when Bob Burman

and Marguerite were put out of the running by the collapse of wheels.

Commercial car builders were not long in adopting the wire wheel after racing had proved its superiority, and it became extremely popular. In recent months its popularity has waned somewhat. Yet while well built wooden wheels undoubtedly are adequate for ordinary driving, engineers still consider wire wheels the more durable and safer form of construction.

Another weakness in automobile construction, affecting the steering gear and reciprocating parts of the engine, was revealed on the speedway. Race drivers found by bitter experience that under great strain and vibration the steel in their cars tended to crystallize. It became brittle and broke easily. This weakness resulted in a catastrophe at the first Indianapolis race, when Jagersburger, in a Case car, broke a steering rod. In trying to dodge him, Harry Knight, who was following in a Westcott, crashed into an Apperson standing at the pit. Both cars were wrecked.

Incidents like this were common in the early days of racing. Nowadays they are

rare because engineers have concentrated on the production of steel that will stand the terrific strain; yet even last year a broken steering knuckle caused the death of Roscoe Sarles at Kansas City.

In such measure do we owe our present driving safety to the fearlessness of the "speed demons"—true sportsmen all—who smile in the face of death and point the way to progress.

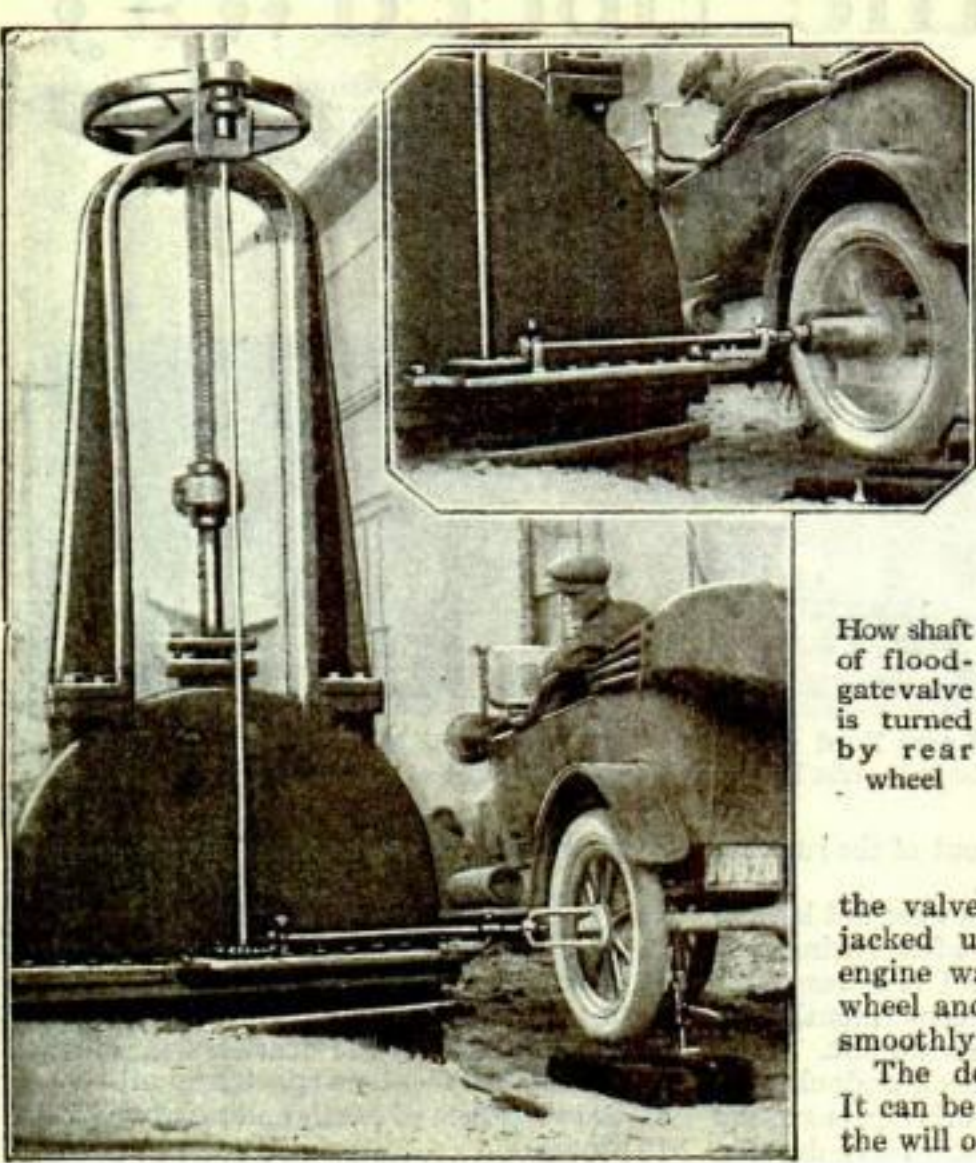
Remember that when a driver drops out of a heartbreaking race, the fault does not always lie in a weakness of his particular car. More often he is the victim of some inherent imperfection that remains to be overcome in the science of motor construction. It was such an imperfection that eliminated Ralph De Palma from the 500-mile race of 1912. Just when victory was within his grasp, when he was leading by 11 minutes and had only two laps to go, a piston broke!

Racetrack Gives Cars Grueling Test

De Palma shrugged his shoulders. "The luck of the racetrack," he called it.

But the "luck" of De Palma and his speeding pals has resulted in strengthening the moving parts of every automobile on





How shaft of flood-gate valve is turned by rear wheel

the valve. Then the wheel was jacked up and the automobile engine was started, spinning the wheel and turning the gear shaft smoothly.

The device worked perfectly. It can be attached or detached at the will of the operator.

ADD one more use to the useful automobile.

At Lovelocks, Nev., the Nevada Valleys Power Company operates a power house at which one of the 48-inch floodgate valves is seldom used. For this reason no electric drive is provided.

But the superintendent owns an automobile, and that auto solved the power question.

A U-shaped piece of metal was fitted over the hub of one of the rear wheels and fastened to the spokes. This piece in turn was fastened to a pinion-gear shaft operating

Rainmaking Airplanes for Montana

ON THE heels of the recent rainmaking experiments at McCook Flying Field at Dayton, Ohio, where airplanes succeeded in annihilating clouds and causing precipitation by spraying clouds with electrically charged sand, comes the report that Richard T. Ringling, member of the famous circus family, has purchased 10 airplanes to be used by professional rainmakers in Montana's dry land farming district.

Ringling announces that these planes, assembled at Great Falls, Mont., will make regular trips to various sections of the state, discharging positive and negative ions of electricity into the air from a wing

of the machine, as it speeds through the air, to form the nuclei of clouds. An attempt then will be made to precipitate the clouds thus formed by spraying them with electrically charged sand.

This process, developed by Dr. Wilder D. Bancroft, professor of physical chemistry at Cornell University, and L. Francis Warren, was described on page 29 of the May issue of **POPULAR SCIENCE MONTHLY**.

Reports from the Weather Bureau at Washington, D. C., indicate the belief of officials that while rainmaking by airplanes may be possible over limited territory, its broader application is doubtful.

Prevents Spilling

A NEW automobile funnel that fits snugly into the radiator inlet and stands erect by itself has been invented to take the place of the old style funnel that had to be held.

This novel device permits the use of both hands in pouring water. In addition, it is



Both hands are free for pouring

rigid enough in its position to support the weight of a pail of water on its edge, thereby lessening the exertion of holding the pail clear at radiator height.

In winter most people empty the radiator every night to prevent freezing, and this necessitates refilling with hot water. Use of the new funnel eliminates the danger of soiling clothes or burning the hands with spilled water.

The funnel has a brass screen strain that prevents any refuse from entering the radiator. Spouts are made in various sizes to fit any car or truck. Each spout has small groove to provide space for the overflow pipe in the radiator inlet.

Novel Fountain Pen Used to Eradicate Ink

TO ERADICATE ink, it is no longer necessary to perform a complicated experiment in chemistry, for the invention, by Thomas W. Cappon, of Newark, N. J., of a fountain pen containing a fluid has provided a simple means of erasing.

The fluid is stored in a glass tube inserted in the fountain pen. A movable glass plunger sliding loosely in a cork stopper keeps the liquid in the tube. By pressing this plunger down on the paper, a small amount of the fluid can be forced out; then, by means of a round knob at the extremity of the pen, the fluid is spread over the writing to be obliterated.

The erasure is said to be complete. When the paper has been dried with a blotter, it is possible to write on it without fear of smudging.



The Ideal Swimming Stroke Found by Science

Double Trudgeon Crawl Helps Champions and Beginners Alike

By Edward T. Kennedy
Swimming Coach, Columbia University

REACHING out into the sport of swimming, science is proving once again that the best way is the simplest way.

Through scientific study of various strokes, experts recently have developed a method of propulsion which, while it has made "learning to swim" an easy problem for the beginner to master, has produced John Weismuller, the swimming speed marvel of the world.

It is called the "six-beat double-trudgeon crawl." Sounds technical and difficult, doesn't it? Yet the foremost swimming instructors and experts agree that it is the ideal stroke for beginners and champions alike.

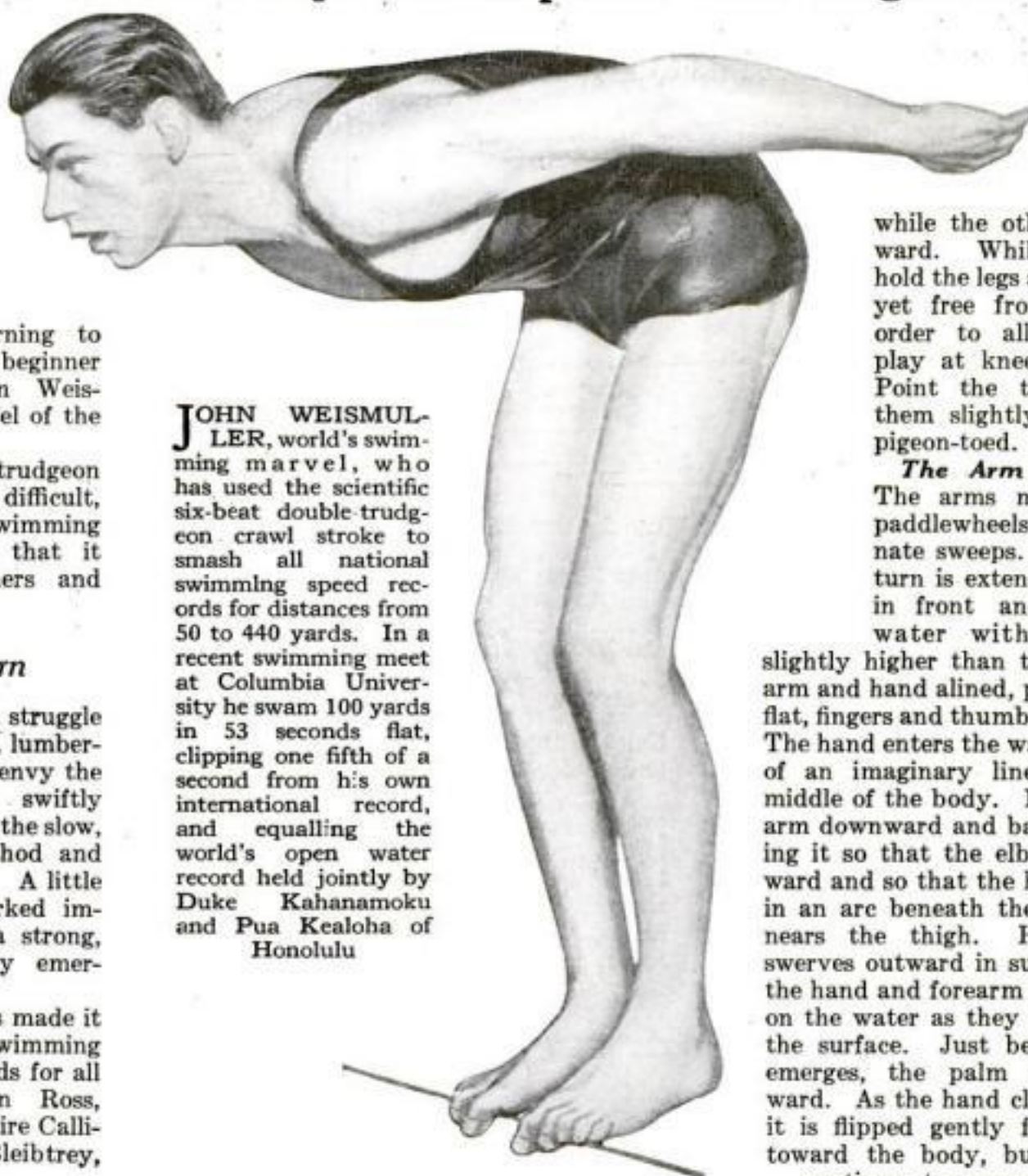
An Easy Stroke to Learn

The beginner, accustomed to struggle laboriously with the old-fashioned, lumbering breast stroke, need no longer envy the "overhand" swimmer plowing swiftly through the waves. He can forget the slow, uninteresting "spread eagle" method and can strike out swiftly for himself. A little practice will bring about a marked improvement; it will make him a strong, speedy swimmer, ready for any emergency.

The six-beat trudgeon crawl has made it possible for the men and women swimming champions to set new speed records for all distances. Weismuller, Norman Ross, Ludy Langer, Richard Howell, Claire Calligan, Charlotte Boyle, Ethelda Bleibtrey, Helen Wainwright, and Gertrude Ederle—all have mastered and used it.

Just as it has increased their speed and endurance in the water, so it will increase the speed and endurance of the most awkward amateur who practises it. In fact, the beginner's improvement will be more marked than that of the expert, for the new stroke will reduce waste of effort and utilize his strength and stamina to the best possible advantage. While it is a real achievement for the racing swimmer to clip a fifth of a second from a record, it will be an easy matter for the average swimmer to cut down his time for any distance by minutes.

This most scientific of all swimming strokes is easy because it is natural. You simply float out on the water, face downward, arms extended, body slightly arched from head to toes, then use your arms as water wheels and your feet as propellers. If you are a beginner, all you need is a bit of confidence. Your lungs are full. You can't sink. As your arms and legs drive you forward, at every full stroke you roll your body to one side, open your mouth, and take a fresh breath of air for the next dip.



JOHN WEISMULLER, world's swimming marvel, who has used the scientific six-beat double-trudgeon crawl stroke to smash all national swimming speed records for distances from 50 to 440 yards. In a recent swimming meet at Columbia University he swam 100 yards in 53 seconds flat, clipping one fifth of a second from his own international record, and equalling the world's open water record held jointly by Duke Kahanamoku and Pua Kealoha of Honolulu.

while the other moves upward. While doing this, hold the legs almost straight yet free from tension in order to allow for slight play at knees and ankles. Point the toes and turn them slightly inward, as if pigeon-toed.

The Arm Movement—

The arms move like two paddlewheels, in long, alternate sweeps. Each arm in turn is extended full length in front and enters the water with the elbow slightly higher than the hand, forearm and hand aligned, palm down and flat, fingers and thumb close together. The hand enters the water at one side of an imaginary line through the middle of the body. Now sweep the arm downward and backward, bending it so that the elbow hooks outward and so that the hand will move in an arc beneath the body until it nears the thigh. Here the arm swerves outward in such a way that the hand and forearm retain leverage on the water as they are brought to the surface. Just before the hand emerges, the palm is turned inward. As the hand clears the water, it is flipped gently from the wrist toward the body, but the forearm continues to move outward as the flip is effected and circles outward, until it points ahead. Then, after the bending of the arm is completed, the elbow moves forward and the arm glides out straight again to easy full reach in front, keeping a few inches above the surface of the water and sloping slightly downward after the hand passes beyond the head.

Stroke Supports Shoulders

During the stroke the arms should be moved independently of the body so that the shoulders will not follow their movements. The movement of each arm should be timed so that it will start its drive from the front before the other arm, completing its drive, relinquishes its pressure on the water at the rear. The catch, or entry of the arm into the water, should be made with sufficient vigor to support the shoulders. The power must then be increased until the arm has reached a point beyond the perpendicular position.

Study carefully the illustrations at top of next page.

As the hand leaves the water, the

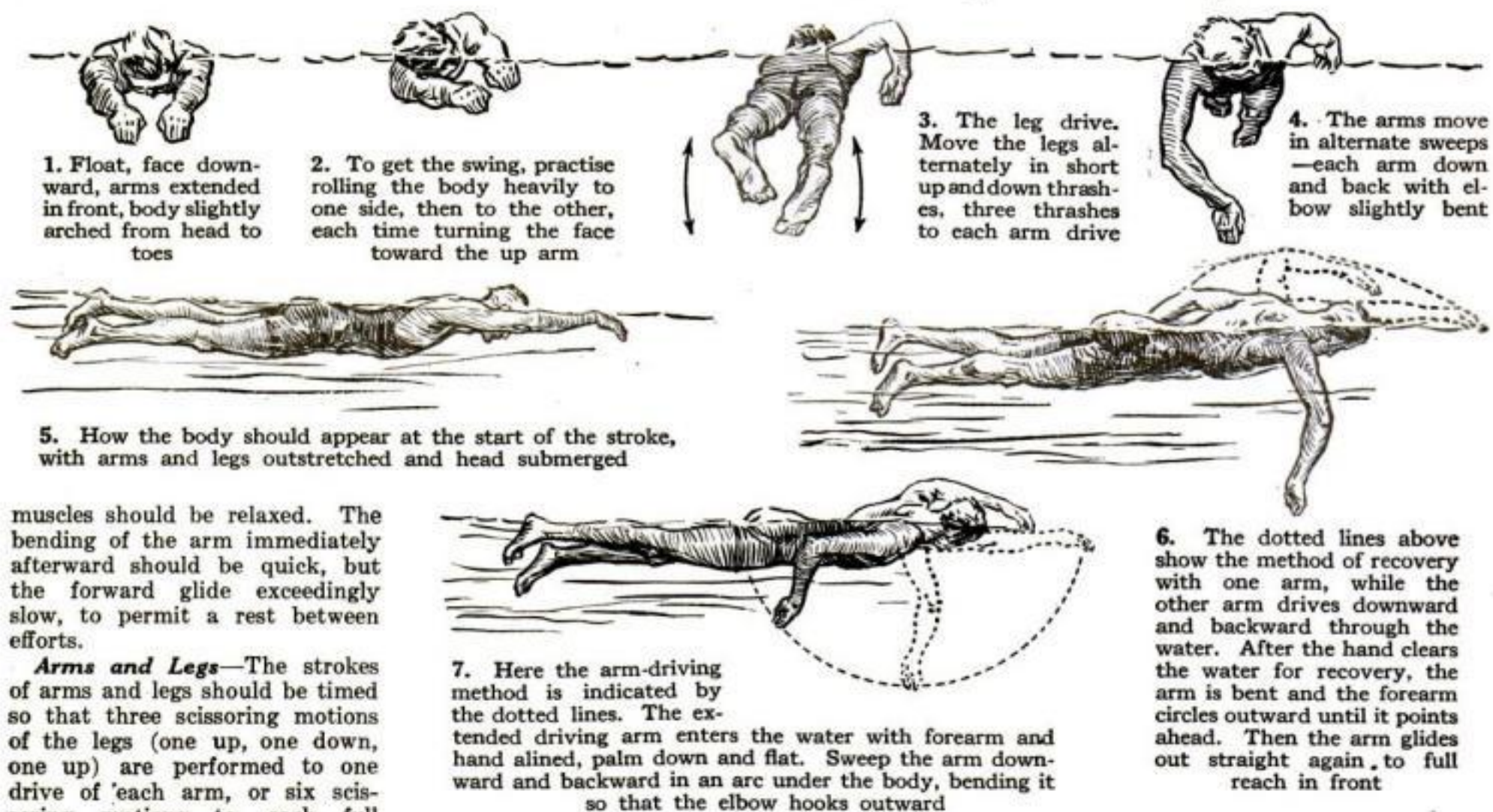


Rolling to one side at the end of his stroke, Norman Ross, one of America's greatest swimmers, raises his face and inhales air through his mouth

To learn the stroke, first practise the leg drive; next, try the arm movements, and finally the rolling and breathing. This is how to do it:

The Leg Drive—Lie out flat on the water, face downward, and move your legs in short alternating thrashes like the beat of drumsticks. One leg moves downward,

How to Swim with a Championship Stroke



muscles should be relaxed. The bending of the arm immediately afterward should be quick, but the forward glide exceedingly slow, to permit a rest between efforts.

Arms and Legs—The strokes of arms and legs should be timed so that three scissoring motions of the legs (one up, one down, one up) are performed to one drive of each arm, or six scissoring motions to each full stroke. The first and fourth of the six leg motions should be more pronounced than the others. These two wider strokes (called majors) should not exceed a movement of more than 13 or 14 inches; the lesser strokes (called minors) not more than from 6 to 8 inches. The thrash of the legs should be easy.

Breathing—Breathing is accomplished by rolling the body and moving the head to one side, whichever side is preferred. This brings the face above water so that the swimmer can inhale a breath of air through his mouth during the recovery of the arm on that side. Then the body rolls back, the head is submerged again, and the swimmer exhales through the nose under water during the recovery of the other arm. During the roll, which, by the way, should not be pronounced, it is very important to start the drive of the under arm before turning the head to inhale and to start the drive of the top arm before turning the head to the submerged position.

Learning to Roll

In learning the stroke, it is good practice at first to roll the body heavily to each side, turning the head toward each arm as it sweeps forward above the surface. But once you have learned to co-ordinate arm and leg action and breathing, abandon this practice. You should roll only to one side to inhale, aiming to conform more and more with the requirements of the standard stroke.

The superiority of the six-beat double-trudgeon crawl is due to the fact that, more than any stroke devised so far, it meets the scientific requirements of effective progression in the water—natural and efficient movements, con-

tinuous application of arm and leg power and avoidance of unnecessary resistance.

All movements are easy and unstrained, yet they give good play to the muscles, afford direct forward impetus and eliminate loss of motion. Propelling force is attained without break in the movements of arms or legs. Resistance is reduced to a minimum, not only because the position of the body and steady progress enable the swim-

mer to take advantage of the hydroplaning principle, but because the arms recover above water and the leg drive is the narrowest evolved to date.

We owe the discovery of the six-beat double-rhythm stroke to American students of the science of swimming. They worked it out in theory several years before it was tested for practical use. At first the leading coaches and swimmers could not be induced to give it a trial, claiming that the fast leg thrash was entirely too tiring to be maintained successfully for more than about 100 yards.

Records Broken with Stroke

So it was left to two New York girls—Miss Claire Galligan and Miss Charlotte Boyle, of the Women's Swimming Association—to prove the value of the stroke. They took it up experimentally in the fall of 1917. A few months later they startled the aquatic world by using it in the women's 500 yards national championship race, which Miss Galligan won. And the following summer both girls succeeded in shattering speed records with it, up to one mile, clinching the evidence of its worth.

One of the outstanding advantages of the six-beat crawl is that it does not require fast arm movements. On the contrary, the steady leg drive permits slowing up the arms without loss of momentum, thus making it possible to retard the recovery and seek complete relaxation between arm pulls. A rapid stroke will prevent full development of either speed or endurance.

Try out this stroke this summer. Time yourself for 100 yards when you first take it up, and again after a month's practice. You will be surprised at your improvement.



HERE is Claire Galligan, of the Women's Swimming Association, who, with Charlotte Boyle, first developed the six-beat double-trudgeon crawl stroke. After other experts had declared the stroke impractical, these two women proved it to be the most scientific and effective of all swimming strokes. With it they set new speed records

Friends of the Home and Garden



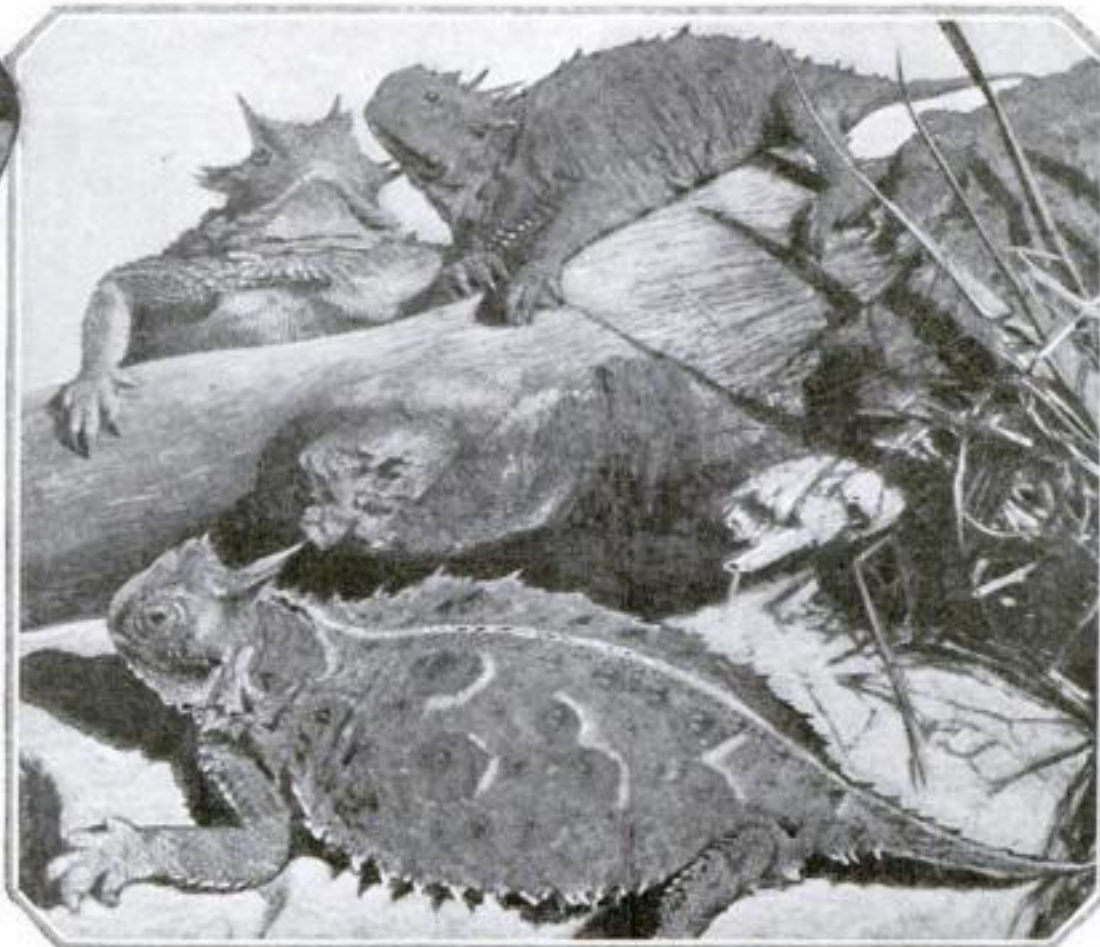
THIS HARMLESS TREE FROG is a friend of the farmer and backyard gardener alike; for it devours countless insects that are injurious to food plants and to grass. It also feeds on disease carrying flies and mosquitos. Thousands of these valuable little creatures are killed thoughtlessly every year



THE BAT, TOO, FEEDS ON PESTS, yet, through the fear and ignorance of human beings, these strange winged mammals usually are killed whenever they chance to enter a home



HE MAY LOOK SLEEPY, but the barn owl above is death on mice. One or two pairs of these birds on a farm, if protected and allowed to rear their young, will catch hundreds of mice every season

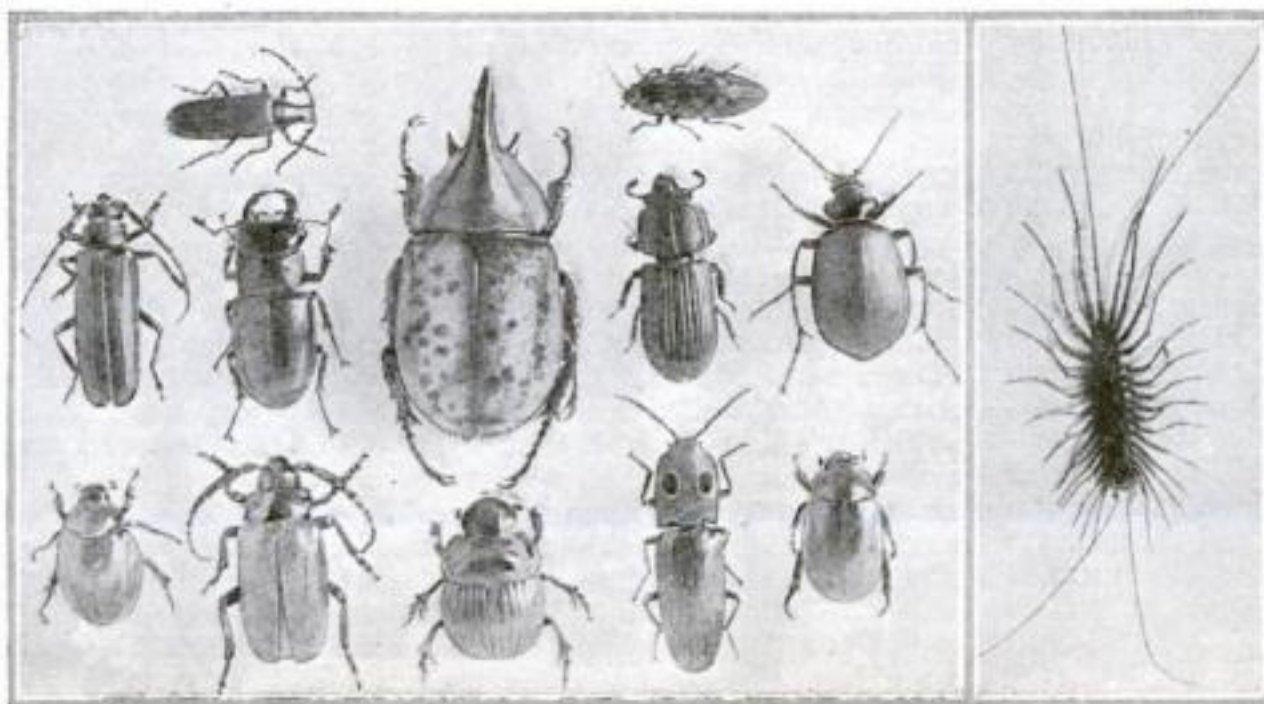


THESE HORNED LIZARDS, incorrectly called "horned toads," are thought to be enemies of man. Instead, they are harmless and make gentle and interesting pets. They are found chiefly in the southwestern part of the United States, where they feed on flies and insects



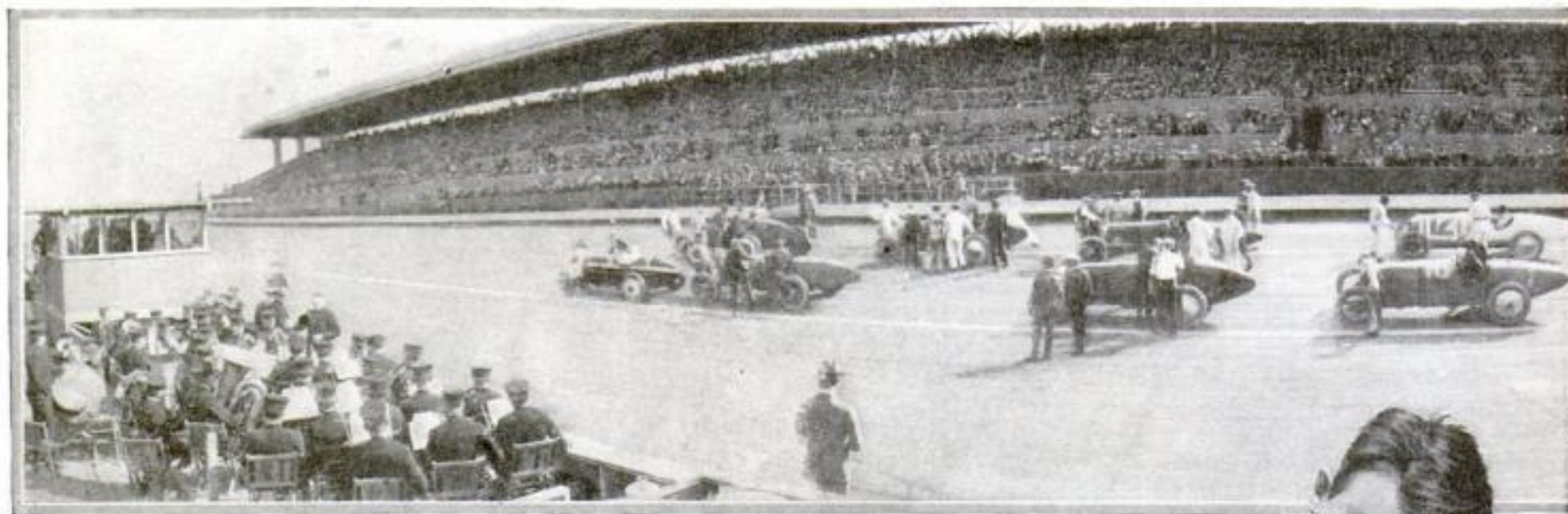
Photographs from life by Dr. R. W. Shufeldt, courtesy The Junior Red Cross News

SAVES THE TREES — Were it not for the industry of the noisy red-headed woodpecker our woods would be stripped of many valuable trees by insects and their larvæ on which this handsome bird feeds



NOT POISONOUS — The belief that the thousand-leg bug (at left) inflicts a venomous bite is false. This creature, often seen running about the house, has been feared and destroyed by housewives, yet it feeds entirely on flies, cockroaches, and other household pests

What Every Motorist Owes to



Awaiting the starting gun at the first motor racing event of the 1923 season—the 250-mile championship race, won by Jimmy Murphy on the Los Angeles Speedway

By E. V. Rickenbacker

Former Race Driver and American Flying Ace

AUTOMOBILE manufacturers are going back into their great motor laboratory—the speedway. Not for the sport of it; not for the big cash awards given the winners; but for its scientific value to the industry. The Packard Company is the first big concern to announce its return to the track. Its cars are expected to figure prominently in this season's events.

Twenty years ago Henry Ford drove one of his first cars out to the old Grosse Point racetrack in Detroit and there, in a thrilling test of speed, matched his creation against the car of Alexander Winton.

What Henry Ford Learned

Ford won. And in winning he learned some valuable new facts about the construction of automobiles. He learned, for example, that the action of springs under great strain is different from their action on a boulevard at ordinary speed. He learned that vibration is likely to break fragile parts. The wear and tear of the racetrack revealed to him weaknesses in construction and materials that were not apparent under normal conditions.

In correcting these weaknesses, in profiting by experience, Ford produced a car that is one of the marvels of the century.

Other manufacturers followed Ford's example. In the early days they took their cars to the speedway laboratory to test them in the crucible of racing. They, too, learned their lessons and profited by them.

Then came the war. The practice of entering stock cars in speed events was discontinued. But the thundering grind of the track had accomplished a definite result: It had established one of the wonder industries of history.

The automobiles that are so indispensable in business and pleasure today are marvels of simply operated mechanism just because they passed through the grueling tests of speed. We drive them in comparative safety and comfort because daring speed kings risked their lives, burned up tires, broke steering gears and crashed into the ditch, or because they skilfully tuned and nursed their throbbing steeds to breathless victories.

And now the makers are returning to the speedway in the hope of still greater en-

gineering achievements. In the further development of motor cars they hope to duplicate the record of fearless race drivers of the past.

Just what is this record? How is it reflected in the modern automobile?

First, in the efficiency of the small, powerful engine. The evolution of the engine from the early models, with a piston displacement of 1000 cubic inches to the present 122 cubic inch size, took place almost entirely on the speedway.

In the early days of racing, an outstanding feature of cars entered by manufacturers was the ever increasing size of the engines, which eventually reached the size of 7¼-inch bore and six-inch stroke. The piston displacement was 1000 cubic inches and the speed of the engine 1200 revolutions a minute. These big cars weighed 2800 pounds—just twice as much as the cars entered this season.

From 1905 the size of engines began to decrease and the engine speed to increase. The first step in this development was to limit the piston displacement to 600 cubic inches and increase the speed to 2000 revolutions. Next, in the races of 1913, the piston displacement was limited to 450 inches and the speed increased to 2500 revolutions. It was at this stage that overhead valves were first used on race cars. Again, in 1915, piston displacement was cut to 300 inches. With a car of this class Ralph De Palma hung up a record of 89.84 miles an hour for 500 miles. Seven years later, Jimmy Murphy broke this record with a piston displacement of 183 inches.

The small engines of 1922 were considered the last word in engine reduction. Designers and manufacturers agreed that any further limitations in size would kill speed. Yet the cars entered for the 500-mile race at Indianapolis this year were limited to 122 inches and the speed advanced to 5500 revolutions. This is considerably smaller than the displacement of



Jimmy Murphy, international racing champion, repairing a broken steering knuckle at his pit

engines in the popular priced small car now on the market. But the engines are as powerful as ever and more economical.

I have gone to some length in describing these engine changes, simply to show the effect of the racetrack on the design of modern commercial cars. If you owned a car 10 or 15 years ago, you will recall the large bore of the engine. And you will recall how, year by year, the size has decreased and efficiency has increased, in step with every development on the speedways of the country.

Europe Working on Small Car

I am firmly convinced that the 122-inch engines of this year's race cars will be adopted generally for commercial cars within a year or so. Even now, in Europe, manufacturers are experimenting with cars much smaller than any ever made successfully in this country.

Reduction in engine size naturally has resulted in decrease in consumption of fuel. In fact, the fuel saving has been almost 4 per cent. With the rising price of gasoline this single economy is tremendously important to every consumer.

Oddities in the News

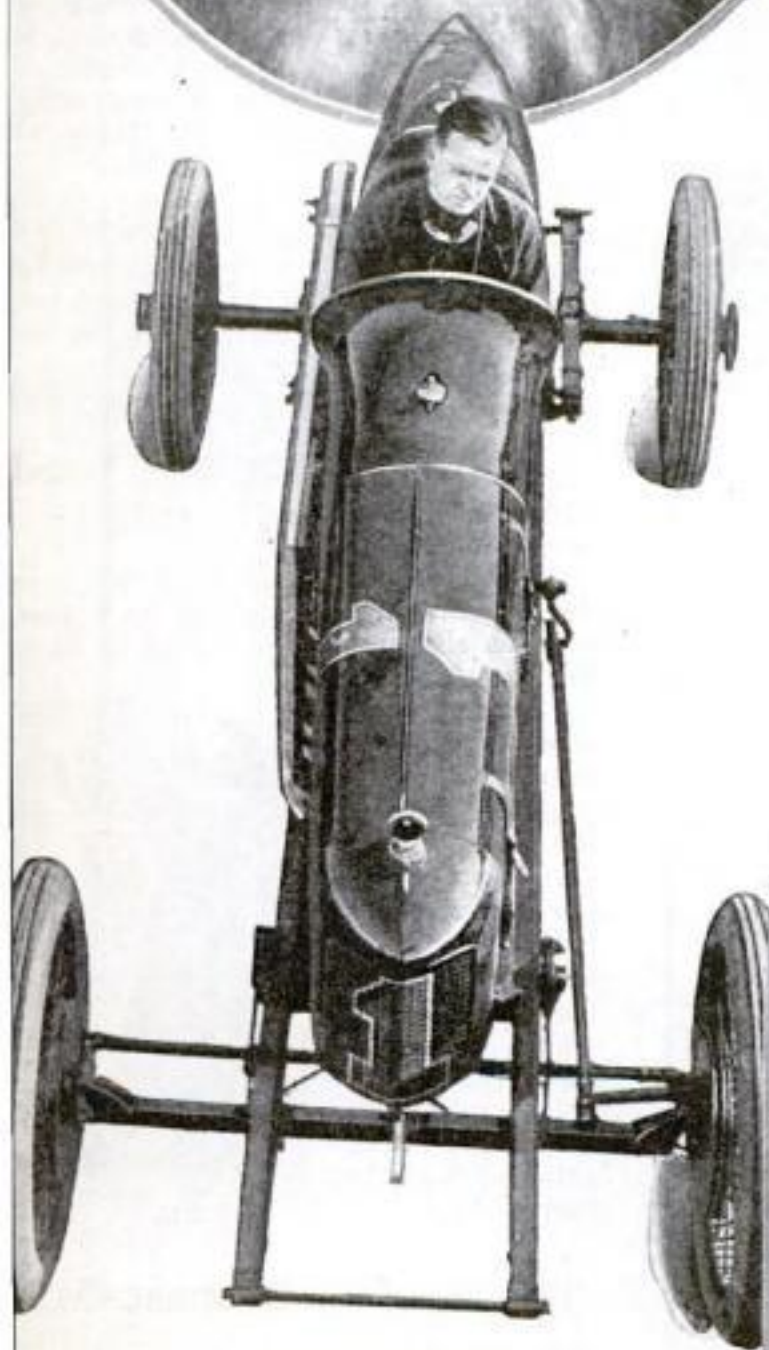
World's Queerest Monkey Caught by the Camera

NOSIEST MONKEY

Here is an unusual close-up photograph of one of the strangest of animals — the long nosed monkey of Borneo, the first specimen of which has just been captured. Naturally he lives in inaccessible places and his capture is considered a great feat



NEW YORK CITY'S TALLEST WATER TOWER in action in the skyscraper district. It rises 65 feet above the level of the street, enabling fire fighters to direct a powerful stream into the eighth floor of a building



TOMMY MILTON DRIVES MIDGET RACER

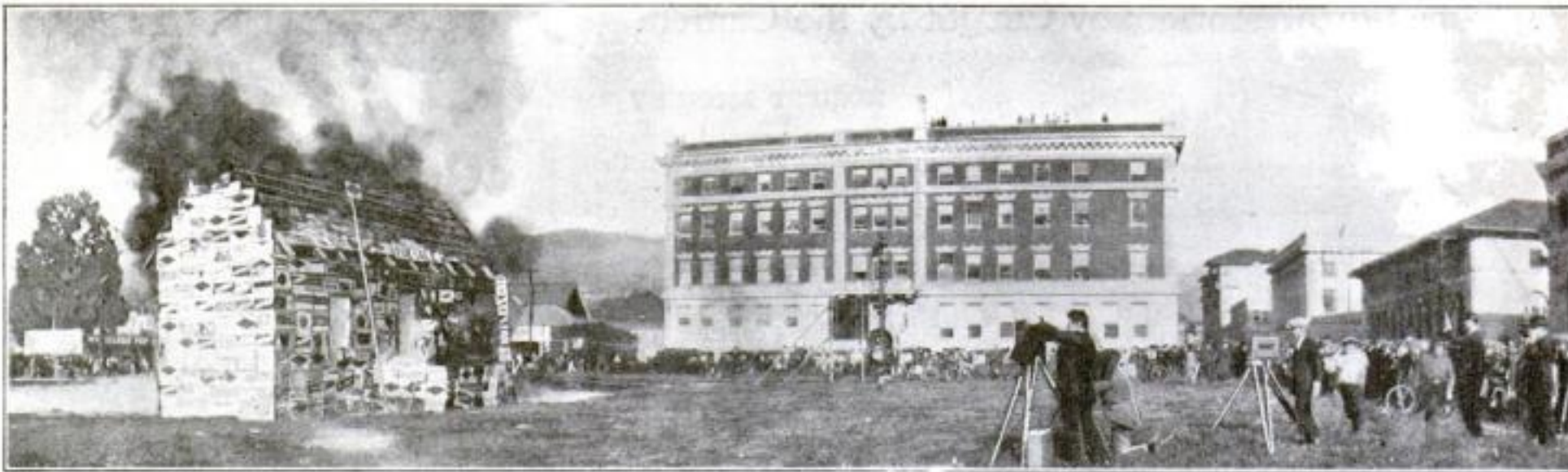
looks like a toy; but this latest creation of famous speed king can travel 100 miles hour. It's the smallest car capable of such speed—a 122 cubic inch, one man racing car, weighing only 1350 pounds, or 750 pounds less than the present 183 cubic inch racers. The frame is only 21 inches wide. The streamlined body looks like a bass horn



WHY GET STUCK IN THE MUD when you can walk on top of it with homemade mud shoes? This inventive Californian has made his out of square boards that are fitted to his feet like snowshoes. To protect his trousers he has added burlap skirts that hang from his knees to the edges of the boards. A mudproof wheelbarrow similarly shod and having a barrel for a wheel completes the ingenious outfit

© Keystone

Burning Up Old "To Let" Signs



Berkeley's (Calif.) Chamber of Commerce decided that "To Let" and "For Sale" signs marred the city's appearance, so the condemned boards were nailed together in the form of a house, the torch was applied, and the ugly signs went up in smoke

Natural Spring Bubbles from Tree

ON A small farm near Bern, Switzerland, can be found a large tree from which water gushes.

At first glance the spring may seem to be an artificial arrangement. Instead, it is simply still another of Nature's curious little freaks.

Not until the tree had attained a considerable growth was there seen any indication of a spring. Then, through a crevice in the side, a little water trickled out. This stream became larger as time went on, until now enough cool, clear water pours out to supply all the needs of the farm, and since the farmer built a trough under the spring, the cattle have made a well-worn path there.

No one can explain just how the spring originated. It is possible that the roots of the growing tree pierced a subterranean stream and that the rising water found least resistance when it passed up through a hollow portion of the tree and then out through a crack in the side.



Courtesy P. B. Yates Machine Co.

One Mulepower Pushes Railway Car

MOUNT LOWE, Calif., which overlooks a panorama of rare beauty, boasts of a scenic railway along which a car, propelled by a mule, carries sightseers up the steep route for a view of the magnificent scenery.

The railway was built single-handed by

a young man who went to the mountains to regain his health.

The car has two longitudinal seats, back to back, which will accommodate 16 passengers. To protect the passengers from the dust kicked up by the mule, the animal is hitched behind the car as shown below.



California Sunflower Grows to Record Height

AS IF to further substantiate California's claim as the state where things assume

record breaking magnitude, Miss Margery Bush, of Petaluma, has grown what is probably the world's tallest sunflower. It was grown in the back yard of her home and measured 15 feet from the root to the top of the flower.

While Luther Burbank has been producing sunflowers a foot high so that they may be consumed by poultry without the necessity of harvesting the large seed-bearing caps, Nature has been working in the opposite direction, as shown in this case.

It is not generally known that several European countries cultivate sunflowers for economic purposes—the leaves being used for cattle fodder, the seeds for food and for oil, which is considered equal to olive or almond oil, and the flowers for the yellow dye that they yield.



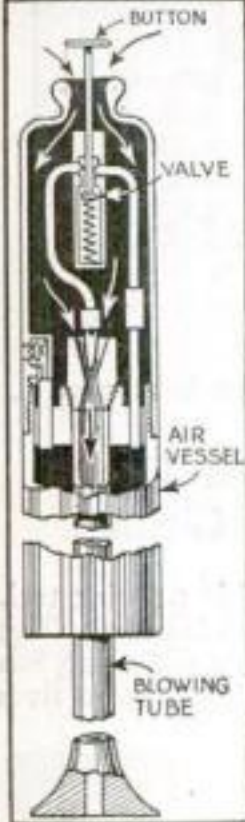
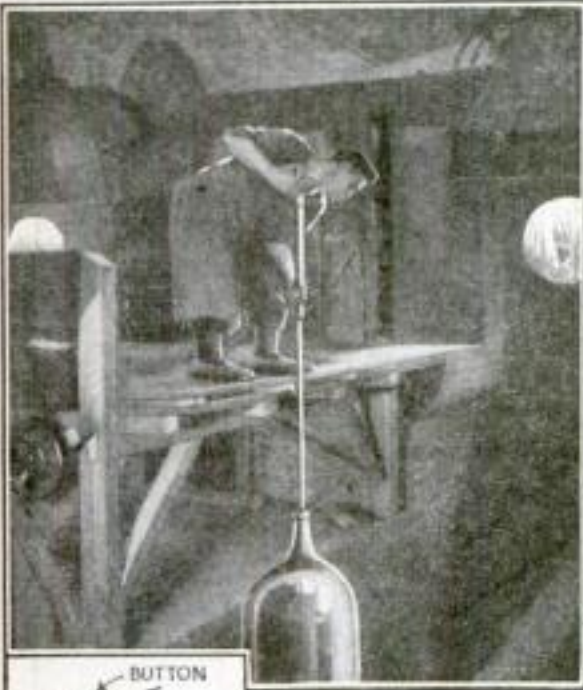
© U. & U.

The World's Deepest Mine

THE deepest mine in the world, the John del Rey gold mine in Brazil, penetrates the earth for more than 10 miles. At this depth the temperature of the rock is 117° F., necessitating elaborate system of artificial cooling.

The great operating problem is the high cost of ventilating and hoisting through a steplike series of shafts and levels which the bottom slopes are reached.

Mechanical Lungs for the Glassblower



THE first successful equivalent of glassblower's lungs recently was invented.

Pressure on a button provides sufficient air in proper velocities to enable the glassblower to perform the most delicate work mechanically.

The button controls a valve in a line leading from a compressed-air chamber. Air passing this valve, shoots into an injector and sucks with it an equal amount of air from the outside. The combined jet of air then passes through a blowpipe.

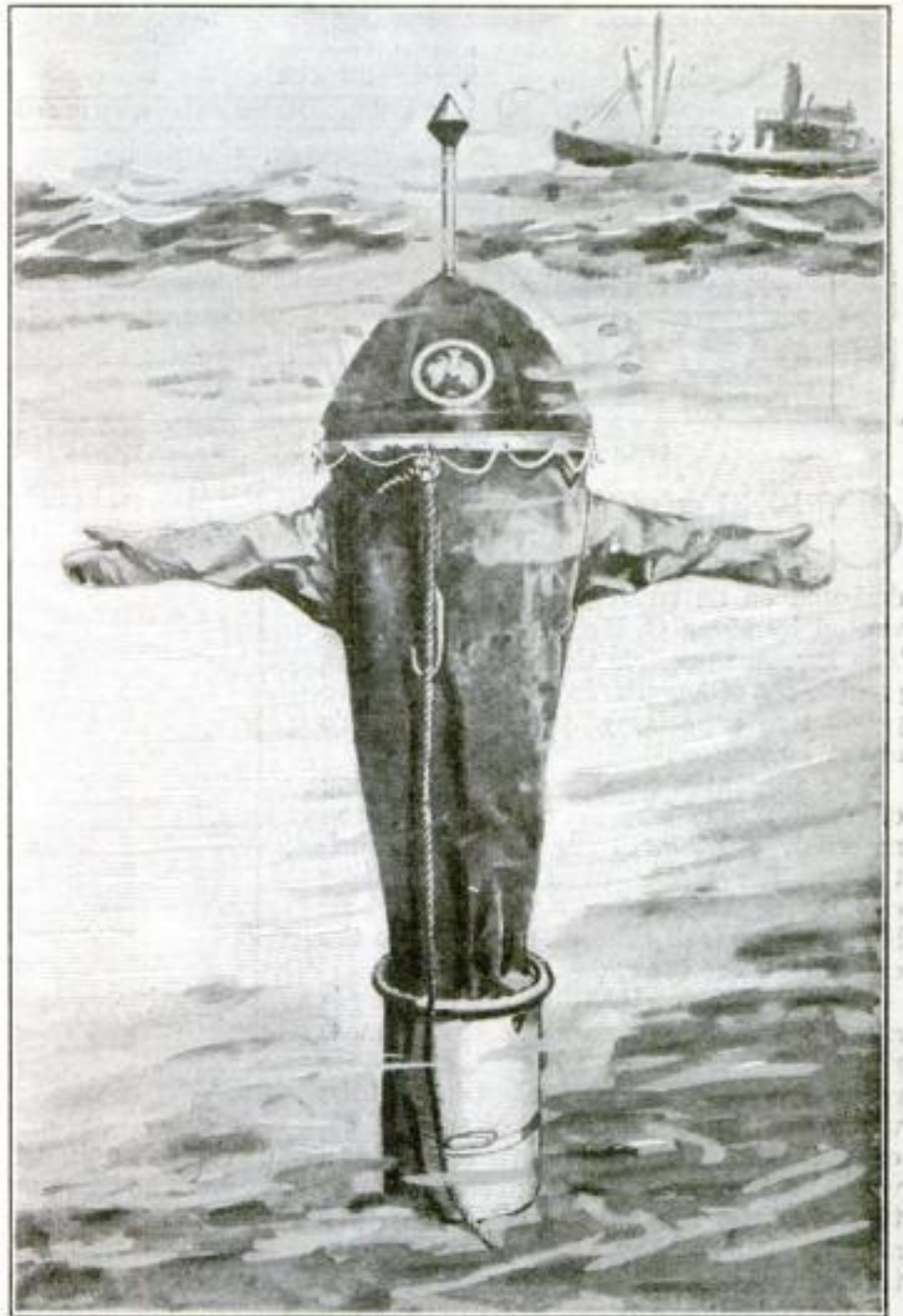
Shipwreck Victim Floats in Buoy

A UNIQUE life-saving apparatus, termed the "skittle peg" by its inventor, a Finnish fisherman, is actually a miniature buoy, large enough to inclose a person standing upright.

It consists of a watertight bag with two sleeves, a bucket at the base and a hood that is provided with a window through which the shipwrecked occupant may look out. The occupant stands on a platform above the bucket.

When in the water, the bucket fills and this weight keeps the bag upright. The watertight sleeves of flexible rubber permit limited motion on the part of the occupant if he attempts to swim.

The air tube at the top extends sufficiently above the surface to permit breathing. Surmounting the tube is a brightly colored cone shaped signal that helps rescuers to locate the victims of a sea disaster.



A water-filled bucket holds the life-saving buoy upright

Hand Cart Wheelbarrow Rides Monorail

A MONORAIL hand cart, designed to replace the wheelbarrow, recently has been invented in Germany, where it is finding extensive use in street railway work.

The car has two wheels each equipped with a double flange. To the frame is attached a long handle with which the operator keeps the car upright and against which he pushes. The wooden box, which



Pushing hand cart along monorail

has a capacity of about eight cubic feet, is mounted on hinges so that it may be tipped to one side when depositing the load.



New Heels for Old Shoes Attached by Hand

DETACHABLE leather heels recently have been invented to afford rapid and inexpensive replacements for worn heels. The upper part of the heel is screwed firmly to the shoe and has a number of lugs that hold the detachable base. Any one can remove the old heels and put on new ones in a few minutes.

Indoor Gardens Grow from Waste Fruit Seeds

AN INDOOR garden that will provide a plentiful supply of table plants can be obtained from fruit pits usually thrown away by the cook. Date stones are excellent for this purpose. Place a number of the stones in a jar of water and soak them for a week; then plant them in a pot filled with rich soil. In a warm room the little date palms will grow quickly.

Plants can be grown easily from grapefruit, orange, and lemon seeds.

Road Sign Maps Answer Tourists' Questions

AUTOMOBILE road signs that anticipate tourists' questions and answer them have been placed at the six main approaches to the city of Madison, Wis. The signs have proved helpful to dozens of parents driving in from distant points to visit their sons and daughters at the University of Wisconsin.

The signs show all the principal points of interest in the city and direct the tourist to these points, which include the university, the state Capitol, lakes and parks, the post office, railroad stations, and trunk highways.



This roadside map directs the tourist

Making Hay while the Rain Pours

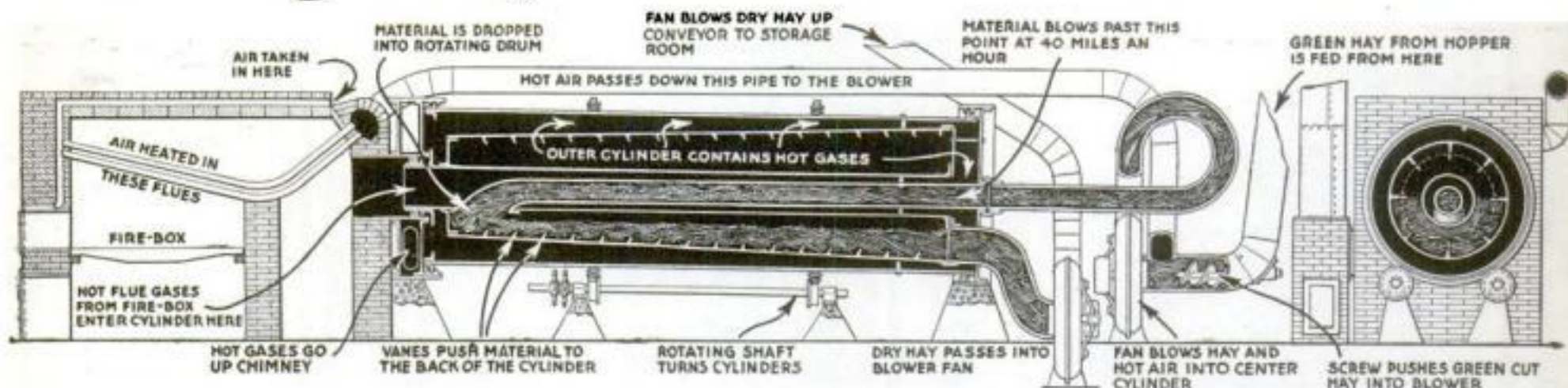
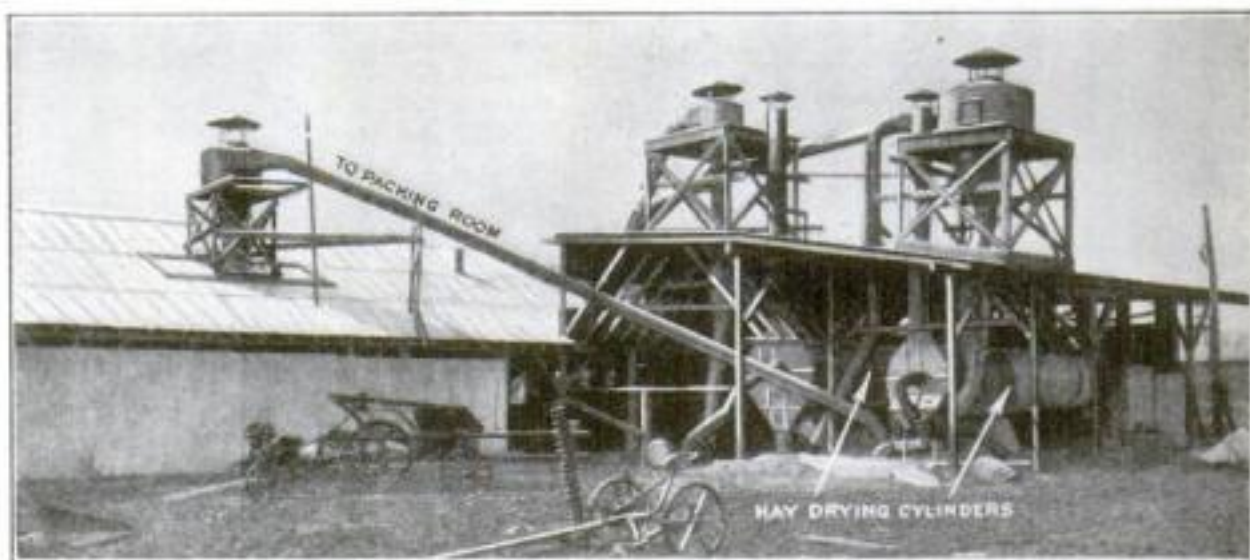


Diagram of haymaking apparatus, showing how hay is dried by hot-air blast



The haymaking plant. Note suction pipe that conveys cured hay to packing barn

CURING green, water-soaked grass in five minutes is the remarkable feat claimed for a haymaking machine designed on an entirely new principle, invented by Nuna C. Hero, of New Orleans. The inventor predicts that it will take the gamble out of haygrowing, and increase the productive capacity of present hay lands about 50 per cent.

The apparatus consists of a dehydrating or drying machine, in which the green material, passing through an eight-inch tube in the center of a large rotating cylinder, is subjected to a powerful hot-air blast. The small tube discharges into the cylinder at the far end.

Running the full length of the cylinder is a series of fins inclined so as to discharge material toward the back, as the cylinder revolves. Around the eight-inch tube within the cylinder are hot-air jackets connected with each other. Smoke and waste heat of the furnace are sent through these jackets, heating the air in the tube and keeping the hay at an even temperature.

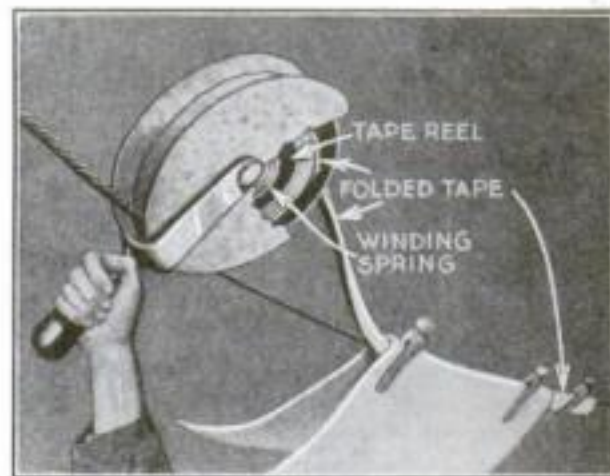
When the green material has been hauled to the dehydrator, it passes first through an ensilage cutter, which chops it into short lengths. From there, it is elevated, by belt, to a point where a blast of air, at 300 degrees temperature, drives it

through the eight-inch tube at the rate of 40 miles an hour, and out into the revolving cylinder.

As the material is worked along by cylinder fins, the wind picks up what has become perfectly cured and blows it into a suction pipe, in which it is conveyed into the packing barn. There it is packed into sacks holding 50 pounds. The entire operation takes five minutes—from ensilage cutter to packing barn.

Novel Line Cover Keeps Wet Clothes Clean

A LINE cover operated in a spring reel, designed to do away with the soiling of newly washed clothes by a dirty line, has been patented by a housewife who lives



Taping line as clothes are hung

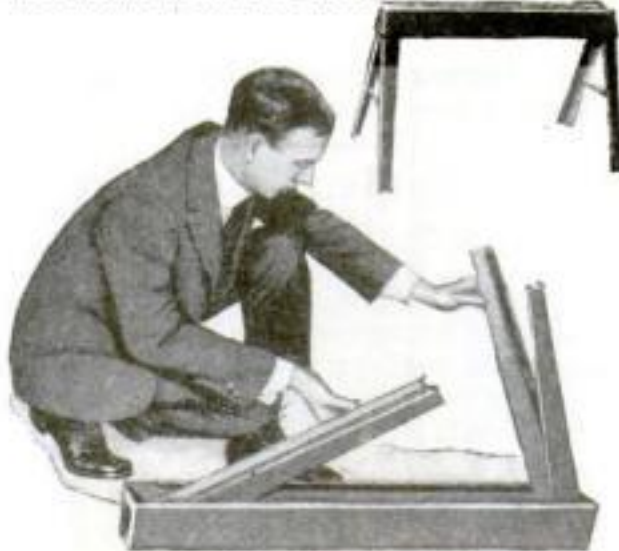
near a railroad. She wearied of doing her week's wash over a second time because the line had been soiled by smoke from passing trains.

Covering the line with strips of cloth gave her the idea for her invention, which consists of a long tape wound on a spring reel that is adjusted so it rides on the line. Entering the reel, the tape is creased so that the soiled surface next to the line is folded upon itself, only the clean sides coming in contact. The device is operated by pinning one end of the tape to the line and running the reel along as the clothes are hung.

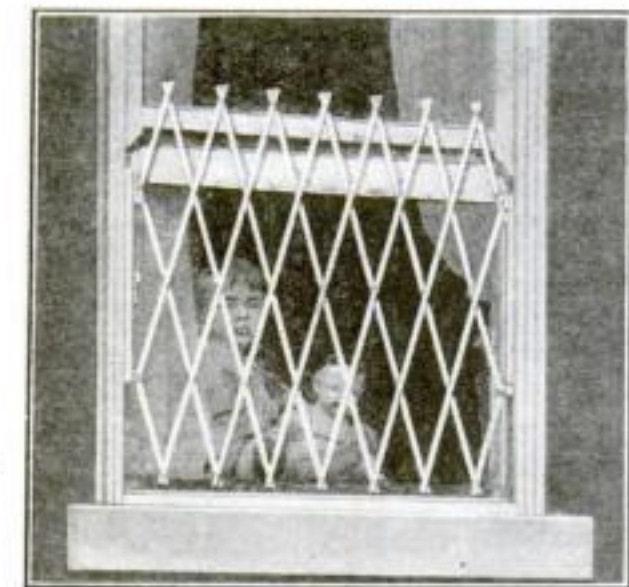
Folding Steel Horse for Use about the House

FOR the man without a workbench, who now uses the piano bench or kitchen chair as a sawhorse, an inexpensive folding steel horse recently has been invented. It may be used as support for temporary workbenches, display tables, banquet tables or platforms. It also has a clamp attachment that serves as a vise.

When folded, the new horse occupies a space 4 by 5 inches by the length of its beam. It may be kept in a carpenter's tool chest or in a closet.



When folded, the steel horse fits the tool chest or closet



Steel Window Guard Keeps Burglars Out, Baby In

EVERY mother who has worried for fear her baby will fall out of a window will be interested in a new removable window guard made of steel bars strong enough to keep burglars out and baby in. It may be taken from room to room as needed and folded away when not in use.

After a channel bar for holding the guard is screwed into the frame of the window, no screws are visible.

The locking device covers all screws so that they cannot be located for removal from the outside.

FOREST fires in the United States average 33,500 annually, reports the United States Forest Service. More than 7,000,000 acres are burned each year, with a property loss of \$16,424,000.

Beetles Eat Telephone Lines

Lead-Boring Bugs Cut and Ruin Miles of Electric Cable in California

WHEN lead fuses blow out on electric light and power lines in California, it is not always due to a short circuit, but often to a lead-eating beetle that penetrates the metallic covering of the fuse and eats away the lead.

This beetle, scientifically known as *Scobicia declivis*, also has destroyed many miles of lead cable covering for telephone lines. The insect lays its eggs in holes that it bores in trees and telephone poles. In these holes the young pass through the larva and pupa stage, emerging as full fledged beetles the following year. Then they fly away on careers of destruction.

To find out why the beetles attack metal and to discover methods of prevention, the United States Bureau of Agriculture recently conducted a series of experiments at Los Gatos, Calif. Within two large screened cages were suspended a number of cables. Numerous freshly emerged beetles were placed in the cages.

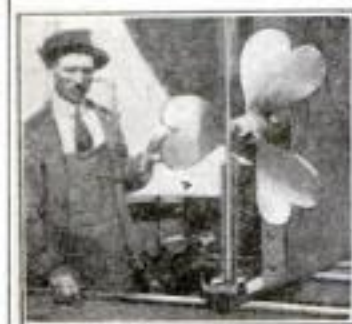
The experiments showed that practically all the boring was done near the contact between the cables and the suspension rings. The reason for this, it was found, is that the beetle requires a foothold from which to attack the cable. Such a hold it obtains by bracing itself against the ring. The holes, about one tenth of an inch in diameter, permit the entrance of water, which short circuits the wires within.

The female beetles do most of the boring, in locating places in which she can lay her eggs. As a preventive, the cables are coated with beef tallow, which sticks to the beetle and suffocates it when it tries to bore.

There are other similar insects that cause appreciable damage to metals. Both in Europe and America there are beetles that eat the quicksilver off the backs of mirrors and still others that devote their energies to removing gilding from chandeliers.

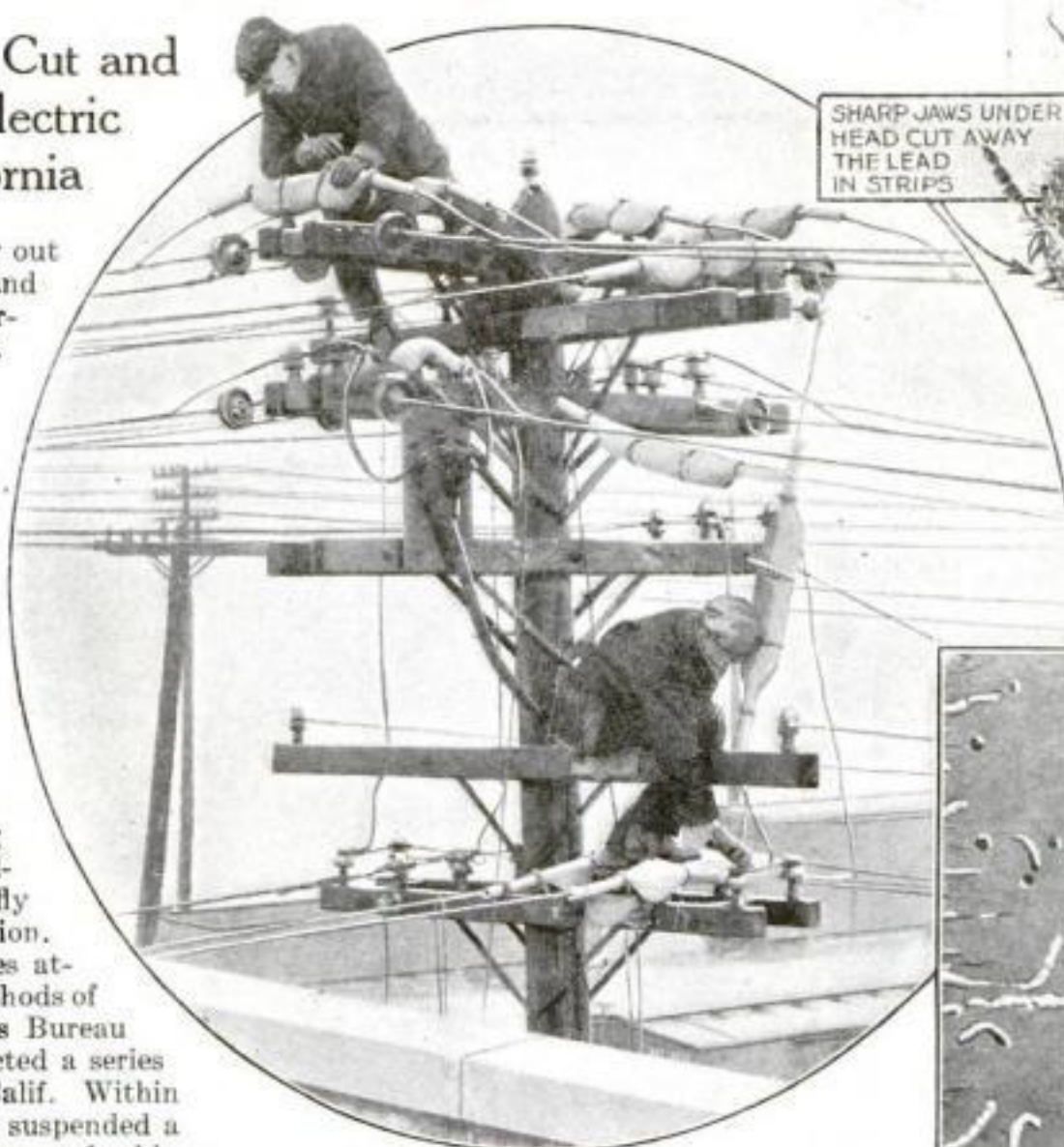
New Cloverleaf Propeller Said to Increase Speed

A NEW type of propeller, adaptable to any size craft, and said to have increased efficiency, due to its queer cloverleaf form, is coming into use on the Pacific coast.



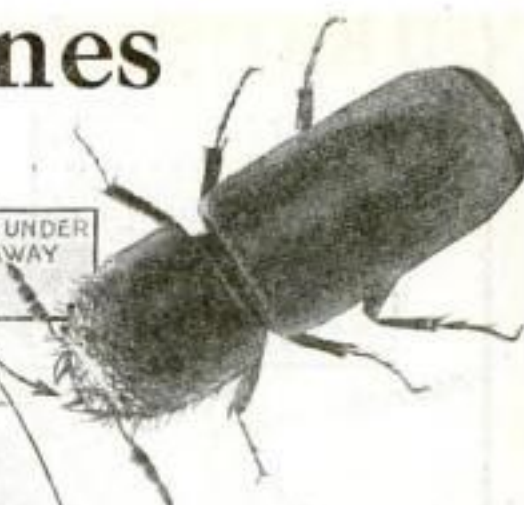
Its widened blades, it is claimed, present about twice as much surface to the water during one revolution, and produce greater speed

than any other propeller of the same size and pitch. The time required to reverse a boat is considerably lessened, it is said.



California linemen wrapping cables with tallow as protection from boring beetles

SHARP JAWS UNDER HEAD CUT AWAY THE LEAD IN STRIPS



With sharp pincer jaws, the lead borer shown above eats away the lead covering of fuses and cables

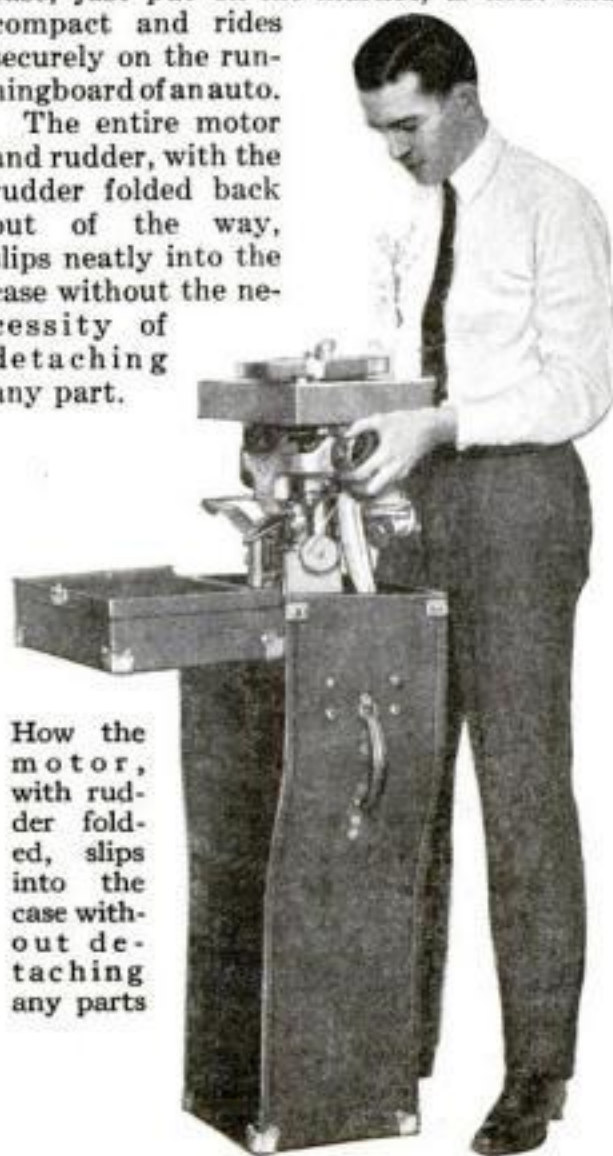


A typical piece of lead cable covering after an attack by beetles

Rowboat Motor Travels in Carrying Case

THE detachable rowboat motor now may take its place with typewriters, stenotypes, and other portable machines in mode of transportation. A new carrying case, just put on the market, is neat and compact and rides securely on the runningboard of an auto.

The entire motor and rudder, with the rudder folded back out of the way, slips neatly into the case without the necessity of detaching any part.



How the motor, with rudder folded, slips into the case without detaching any parts

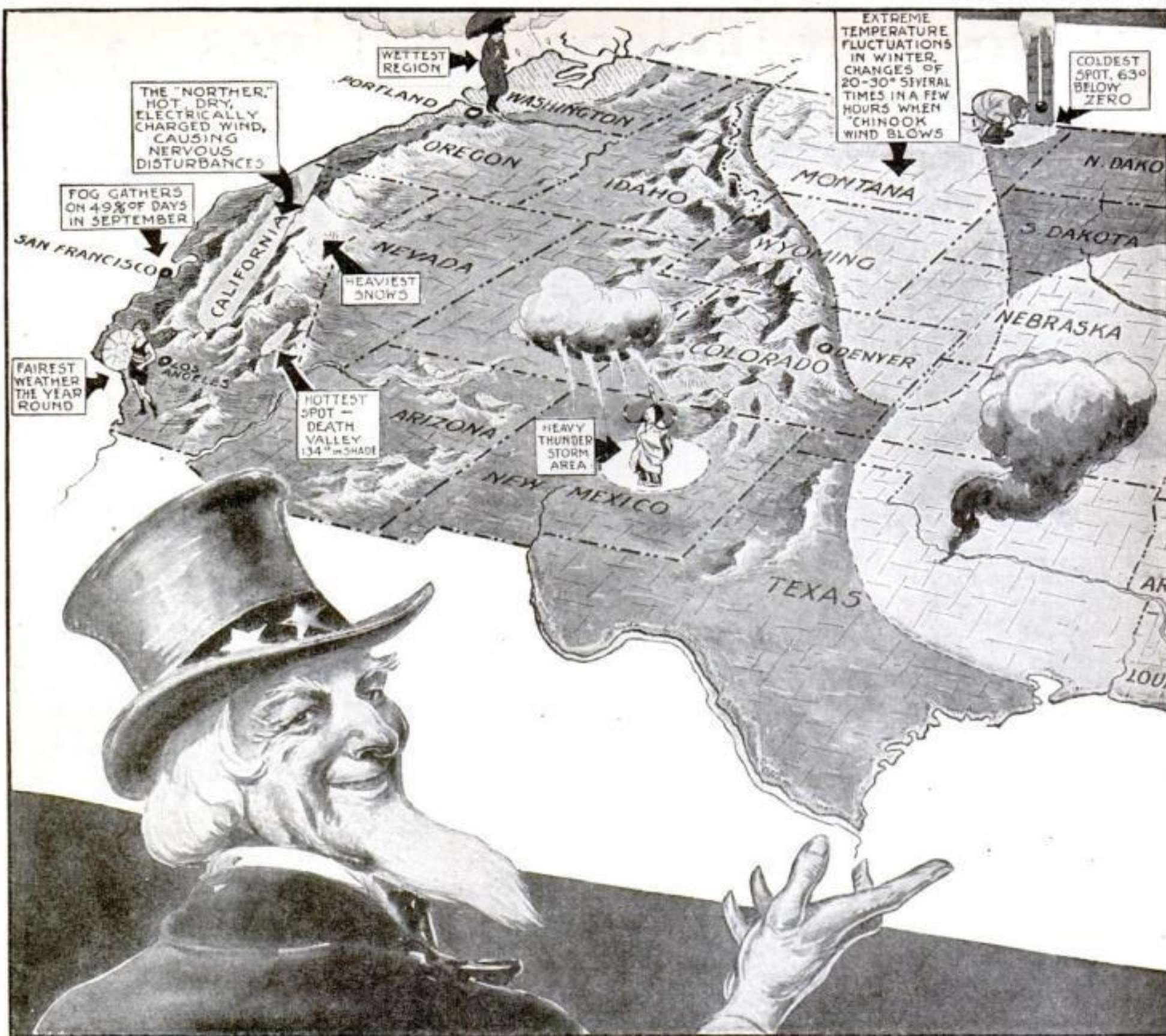
Eggs Locked and Padded for Safe Shipment

EVERY farmer, freight handler, and commission man engaged in handling eggs will welcome the invention of a new cushion locked pad for egg crates, which is said to reduce breakage to the minimum. The honeycomb containers are made of light cardboard and are backed by a corrugated strip of padding for each row of eggs.



A corrugated pad keeps eggs from slipping

These strips provide cushions between the layers of eggs. They also lock the honeycombed filler sections tight, preventing slipping as the cases are handled. Continual sliding on the smooth cardboard pads in common use is said to be the cause of a large percentage of breakage in transit. With the new pad each egg is locked and padded in its own compartment. It is reported that shipments packed in this manner, greatly reduced loss by breakage.



The Truth about the Weather

Told to Robert E. Martin by James H. Scarr

New York District Forecaster of the U. S. Weather Bureau

SOME 20,000 individuals ask me questions about the weather every year. Weather questions pour into our New York office over three trunk telephone lines at the rate of one a minute on ordinary days. At the first gust of an approaching storm, the calls often mount to 10 a minute. On such days, the telephone company reports that within eight hours as many as 1500 calls have failed to reach us because our lines were all busy.

And while we are trying to answer these innumerable questions over the phone—while we are telling one man whether the moon shone a week ago last Thursday, and another that we can't possibly predict how much rain will fall day after tomorrow—other people, gathered in the office, are asking the weather man for personal help in solving their business and domestic problems.

A widow came in the other day to inquire what city she should move to in order to save her son from recurrent attacks of pneumonia. An excitable husband was waiting to ask if there was any place in the

country where thunderstorms never occur. He said he wanted to move there, because during every thunderstorm his wife kept him awake all night with her terrorstricken complaints. Next him was a young business man who said he dyed straw for straw hats and wanted help in determining just what conditions of temperature and humidity would be best to make his process effective.

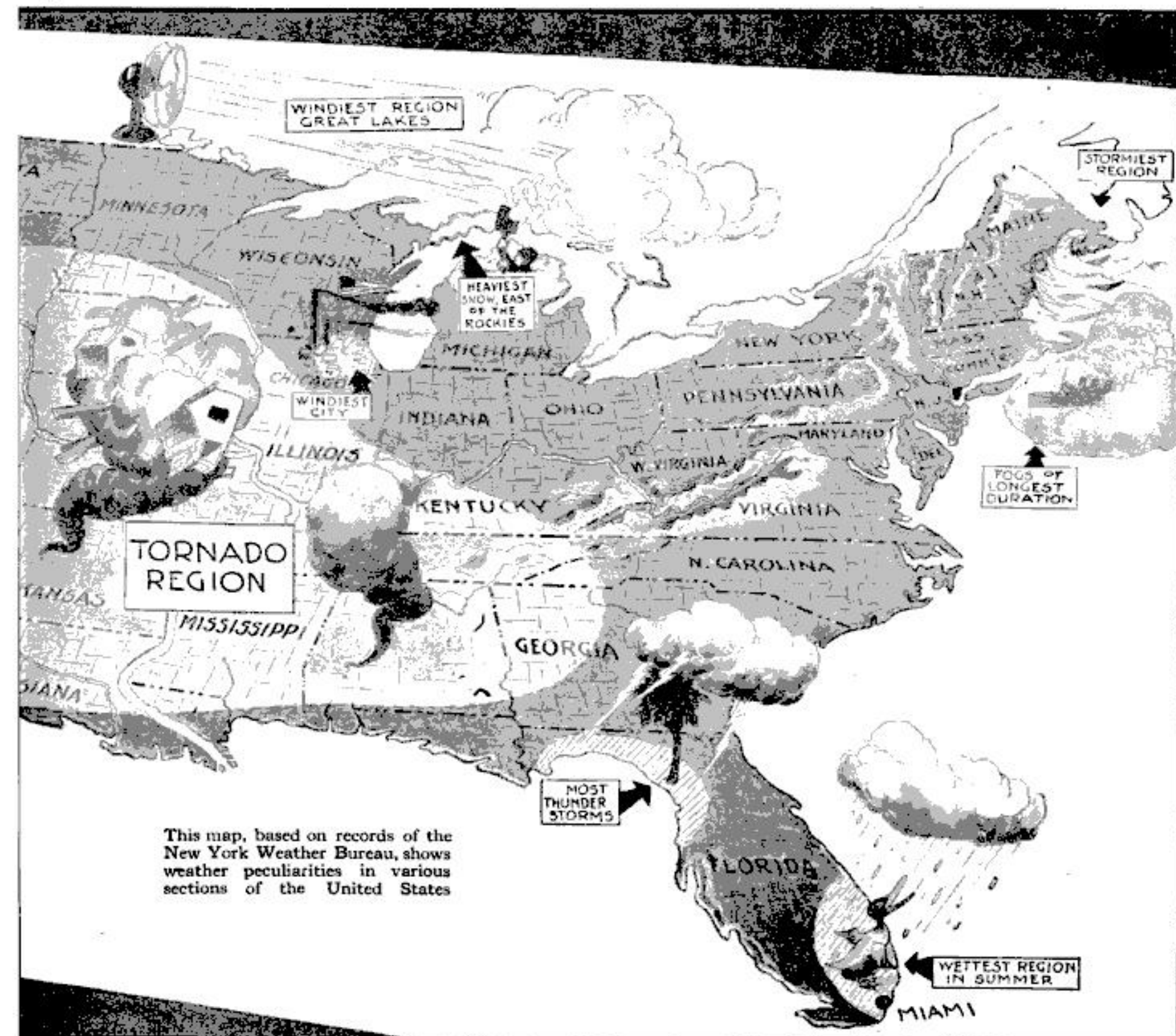
Meanwhile the flood of telephonic inquiries continued. Fool questions? Not a bit of it! Earnest, honest-to-goodness inquiries that help to regulate every human activity or interest, from washing to weddings, from food crops to street cleaning, from week-ends to wearing apparel, from coal supply and construction to advertising and after-theater suppers.

Every Friday afternoon in spring we are bombarded with feminine voices over the telephone asking about the week-end forecast. It seems as though nearly every office girl in town who has access to a telephone is anxious to know whether she can safely plan a Saturday afternoon excursion.

A worried Brooklyn housewife wants to know whether it will be safe to have her laundress come tomorrow, "or will it rain?" A timid young woman pays me a personal visit to inquire whether the weather will be auspicious for her wedding next Wednesday.

Among all these hourly proofs that Mr. Average Citizen finds the weather man a constantly useful assistant in his daily affairs, the question that crops up most frequently is whether the winters aren't getting warmer and the summers cooler than they used to be. This seems to be a universal popular belief. I have prevailed in every adult generation for centuries, and is continually cropping up anew.

Only last winter, Chicagoans began to lay claim to a milder climate than they used to have. They alleged that the city is now enjoying the warmer winters characteristic, 20 years ago, of regions 250 miles farther south. And yet the most conclusive weather bureau figures prove that over a period of many generations the climate of the United States hasn't changed in a single distinguishable item.



This map, based on records of the New York Weather Bureau, shows weather peculiarities in various sections of the United States

"Well, but I know the snowdrifts were higher when I was a boy," a friend of mine said to me the other day, "and the blizzards were lots fiercer; while I can remember glorious skating days unequalled by anything the youngsters have now."

"How tall were you as a boy?" I asked in reply. "Just remember that snowdrifts that now only reach your knees, used to reach above your waist. The drifts weren't a bit higher, but they looked like mountains to you then. And your memory is the most deceptive thing you have. One or two isolated blizzards stand out spectacularly in your mind and color your impression of whole winters. The youthful glamour around a few days of fine skating has so grown upon you in recollection that you forget the innumerable days of thaw."

Perhaps the American people discuss the weather so continually because more weather freaks and more extremes of climate affect the United States than any other great nation on the globe.

A single one of our states—California—can boast that it harbors, almost side by side, the hottest spot on earth, the pleasantest year-round climate, and the heaviest snowfalls in the country. Up in the north-west corner of the map, around Puget Sound, America's rainiest cities thrive,

Is Our Climate Changing?

OFTEN we hear oldtimers say that our winters "ain't what they used to be"—that we no longer have the fierce blizzards, the bitter cold that we did "when I was a boy." Most of us have thought the same thing.

Is it really true that the earth is growing hotter? Or is it growing colder?

A few years ago science held to the theory that the earth, a big heated ball, was gradually cooling off. Today scientists, in their study of radium, are investigating a theory that the earth actually may be growing warmer under the influence of radioactive forces.

Which is right? "The most conclusive Weather Bureau figures," answers James H. Scarr, famous New York weather forecaster, "prove that for many generations the climate of the United States hasn't changed in a single distinguishable item." Read what he says about it in this article.

while in the opposite corner, New England rises to confess that she is stormier, foggier, and more afflicted with cold waves than any other part of the land.

The coldest spot in the country is Poplar, Mont., where the temperature has been 63 degrees below zero in January.

At the other end of the thermometer stands the sizzling high mark of 134

degrees in the shade, officially noted on the weather bureau instrument at Greenland Ranch, Death Valley, Calif. If the temperature should rise to any such point as that in the more humid portions of the country, the population would be pretty nearly wiped out overnight.

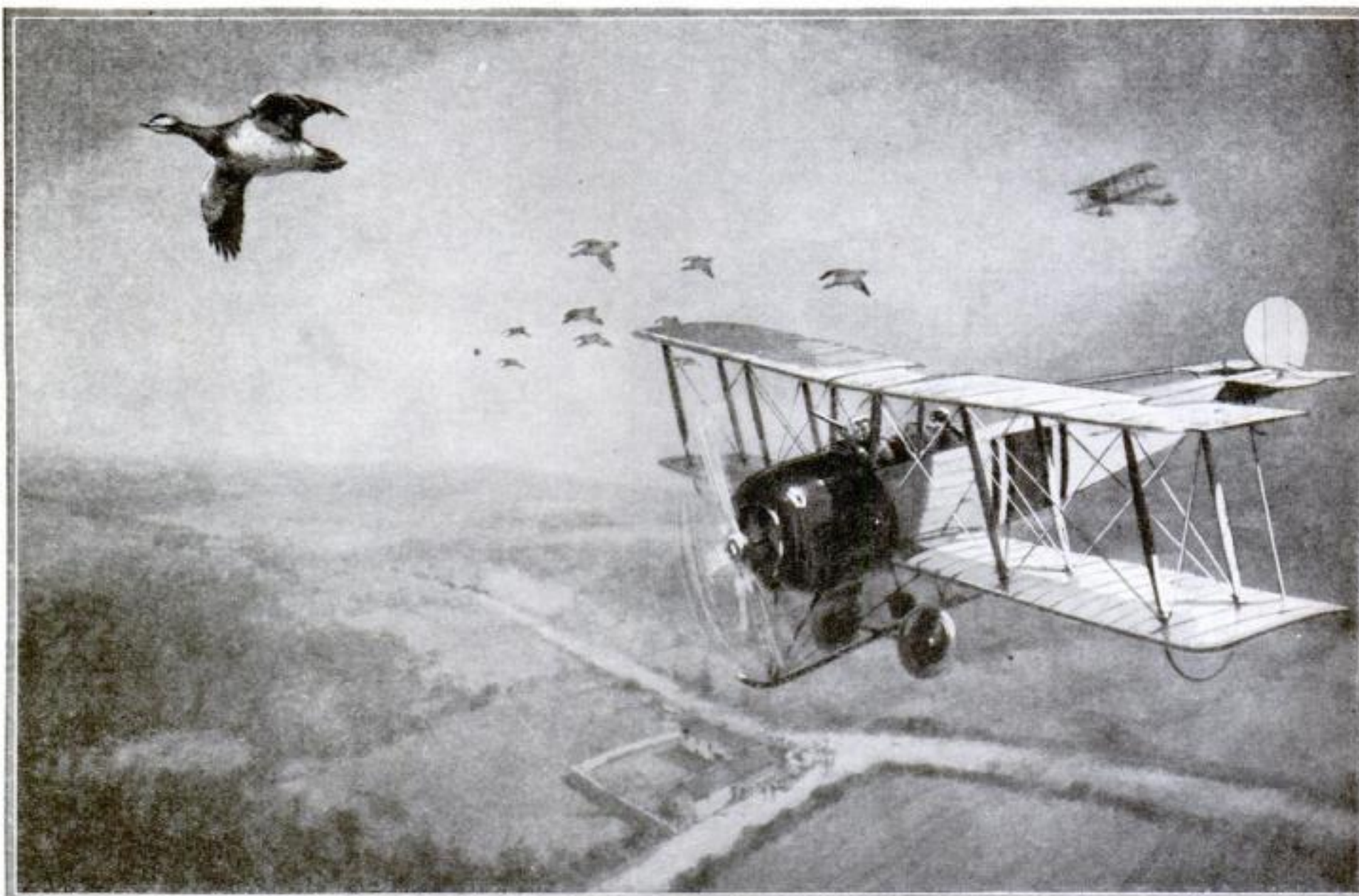
Outside the extreme northern portions of the United States, between the Rockies and the Great Lakes, the coldest winters are experienced in the region around Ogdensburg, N. Y., and thence eastward to Lake Champlain, northern Vermont, New Hampshire, and Maine. There a temperature of 40 below zero has been recorded.

Weather Bureau records beginning in 1871 show that no spot on the mainland of the United States has wholly escaped freezing weather; Key West alone has been frostless. Zero weather, however, never has touched the Pacific Coast, although it has reached as far south as the gulf coast of Mississippi and Louisiana.

Minneapolis, St. Paul, and Duluth are the largest cities that enjoy 'way-below-zero temperatures, and they likewise are the largest cities with a pronounced annual range in temperature covering more than 100 degrees. The greatest yearly range in

(Turn to page 56)

Hunting Big Bustards by Airplane



THIS picture shows a thrilling moment in the newest air sport—hunting the great bustard, Europe's largest bird, by airplane. This sport was originated recently by Spanish aviators attached to an airdrome on the southern plains of Spain, where the huge birds are plentiful.

The great bustard, of the species of long shanked wading birds, is found in Europe in small flocks of eight or 10. The largest

of the males weigh from 30 to 42 pounds, are four feet long, with a wing spread of six or seven feet. Because the birds are unusually timid and suspicious, it was extremely difficult to bag them until their new enemy, the airplane, appeared.

One of the Spanish aviators, Lieutenant Lecea, recently conceived the idea of running down a flock of bustards, separating one bird from the group, and of pursuing

that bird until he tired it out and forced to land. This was soon followed by a new phase of the sport—driving an airplane into a flock as soon as the birds rose, and shooting at them from the cockpit of the machine. Hunting of this kind requires skill, for the gunner is hampered in his shots by the limited horizontal range of the gun, due to the ties and struts of the machine.

About the Weather

(Continued from page 55)

temperature is in eastern Montana and the western part of the Dakotas. Residents of Huron, S. D., have seen their thermometers cover a range of 151 degrees in a year.

Among the great cities of the country, the average monthly temperatures during a year is lowest in San Francisco, and highest in St. Paul. San Francisco's average monthly temperature is 50 degrees in winter and 60 degrees in summer.

The driest portion of the country is the region of Death Valley, while the driest big cities are San Francisco and Los Angeles, which are rainless in July and August. The maximum monthly rainfall in Los Angeles is three inches—in December—while in Astoria, Ore., Jupiter Pluvius lets loose as much as 13 inches of rain in one month.

When it comes to thunderstorms in these rainy cities of the Northwest, they occur at the rate of only about two a year; while right around the mouth of the good old Suwanee River, in northwestern Florida, is the champion thunderstorm region of the land. Ninety thunderstorms a year are the average in this region. Farther south, Miami is treated to the rainiest summer climate in the country.

The snowiest region in the United States

is on the Sierra Nevada and Cascade ranges, where snow 30 feet in depth has been noted. Northern Michigan has the heaviest snow outside of the Western mountains. Here a snowfall of over 100 inches a winter is not uncommon, as compared with less than half that average around New York City.

The extreme northeast coast of Maine is the foggiest part of the United States; here there are an average of 1600 hours of fog a year; while the famous San Francisco fogs, which sweep in as regular as clockwork in the summer, total about 1100 hours a year.

Besides being the foggiest, the New England coast is the stormiest part of the country. The region of the Great Lakes and the Western plains are the windiest in the interior. Chicago, in the heart of the Great Lakes region, lives up to its name of the Windy City by reporting the high average annual wind velocity of 16 miles an hour, as compared with an annual average velocity of four miles an hour at Lynchburg, Va.

St. Paul is credited with the highest wind velocity ever reported over a five-minute period—102 miles an hour. One of the outstanding tornadoes of American history struck St. Louis on May 27, 1896, when the velocity of the wind is said to have exceeded that of a rifle bullet.

Coal Is Now Delivered by Novel Suction Pipe



A MANUFACTURER from the Midwest thought of using the vacuum principle for delivering coal. The mouth of the suction pipe is placed at the edge of a heap of coal, which is literally sucked to its destination, whether it be from a street into a house cellar or from freight train to coal wagon.

Of course, only small coal can be disposed of by this method. One man can handle 20 tons of fine coal an hour.

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Your Vacation—How to Make It Pay

Noted Health Expert Prescribes the Ideal Scientific Summer Outing, Especially for Young Men, to Rebuild Worn Parts of Mind and Body

By C. Ward Crampton, M.D., National Boy Scout Councillor



THE RIGHT WAY
 Sketched by Doctor Crampton



Up at daybreak for a dip in the lake



A mess of bass for a healthy appetite



A sound sleep on balsam under the stars



Home again—a new man

EVERY man needs a vacation; some men need it more than others. The experience of thousands of young men has proved beyond question that the right kind of summer recreation can return a tremendous profit in health, happiness, and efficiency for the months of work that follow.

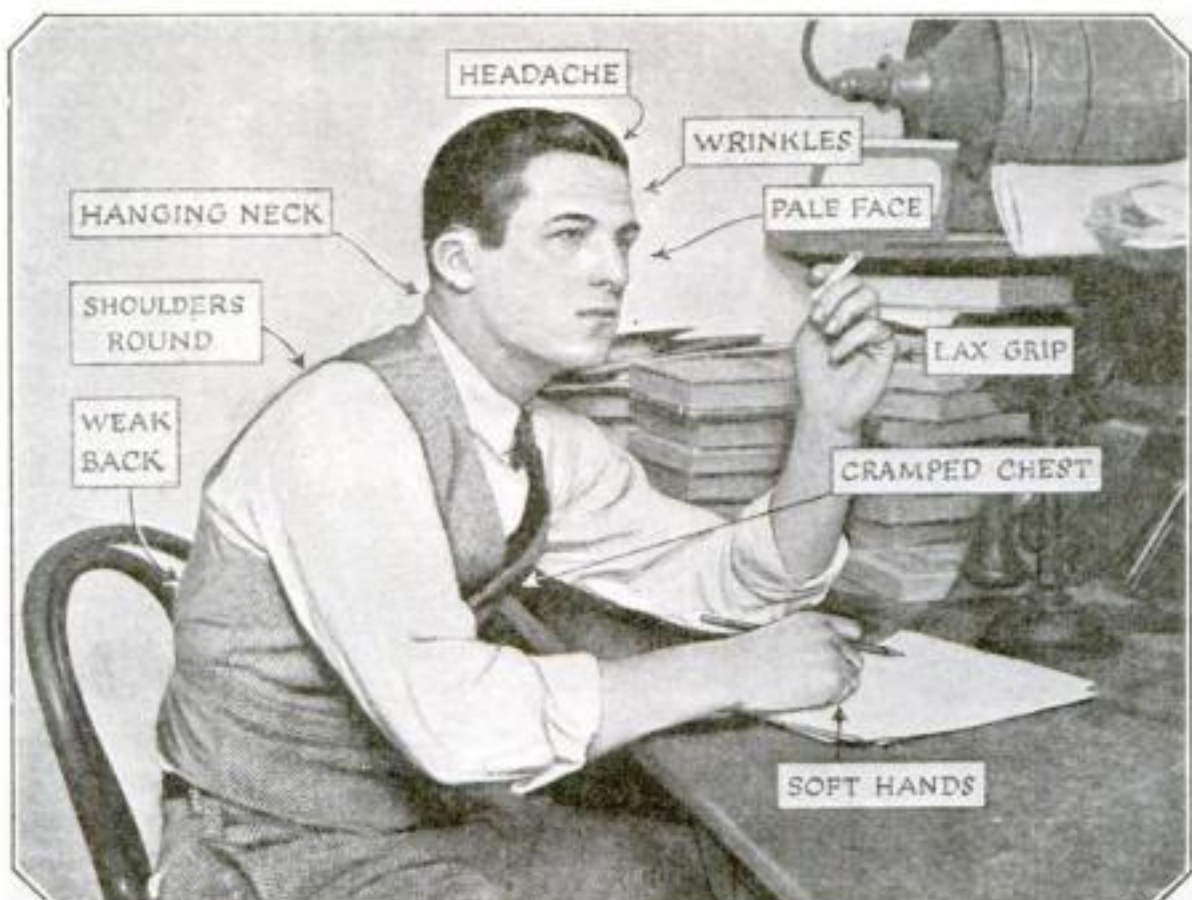
Yet the fact remains that a majority of vacations are wasted, usually through sheer thoughtlessness and lack of purpose.

It is the ambitious young man, eager for success, who asks: "How can I get the most value out of my vacation?" Hundreds of busy young men ask me that every year. And here's my answer:

First, take stock of yourself. Go to a reliable physician for a complete overhauling. Find out just what parts of your body machinery are weakening under the daily grind. If your work is indoors, at an office desk, probably you have a weak back that needs repairing. As the result of careless posture your shoulders sag, your chest and abdomen are cramped, your neck droops. Your muscles are flabby, your face pale and wrinkled. You suffer from headaches and stomach disorders.

What you need is the vigorous kind of summer recreation that will expand your chest, allow your lungs to grow; tune up the mechanism of your stomach, intestines, liver, and other internal organs; harden your muscles and strengthen your heart.

If you are a wise young man, you will take time to study yourself. But in these



The wise young man, says Doctor Crampton, plans his vacation first by taking stock of himself to find what parts of his body need repair

days of jazz, you will be tempted to join the Vacation Boob. He is the vacationist who hops the first train for a breezy summer resort. He climbs off the train and into a bathing suit, gets chilled, lies on the beach to warm up and acquire a handsome coat of tan. Then, with an appetite like a horse, he hurries to dinner. He eats too much. Afterward he dances until midnight. Finally, at two a. m., he goes to bed, only to toss wakefully to the tune of sunburn.

On the beach again next day he is the object of solicitous feminine care while the blisters rise. The skin comes off his back and legs. He goes rowing, and the skin comes off his hands. He goes hiking in tennis shoes, and the skin comes off the bottom of his feet. Finally he returns

of the country about the camp, followed by luncheon, a loafing afternoon, and a good mess of black bass for supper. Another night of luxurious balsam, and on the morrow a canoe trip around the lake.

That's his program for the next 12 days, and all the while he is breathing deeply of clean, fresh air; his lungs are expanding, his muscles are hardening, his heart settles down to strong steady work, and every part of his digestive machine begins to function smoothly. Each day is crammed full of solid enjoyment and health building. And he returns to his office with new vigor, enthusiasm, and energy. He has saturated himself with the power of all out-of-doors.

And that's the kind of vacation that pays.

to town literally skinned by his vacation. If he is no worse off than merely used up physically, he is lucky.

But if you are wise, you will follow the example of a young bank clerk I know. The first morning of vacation finds him getting off the train at Hickey Corners. By noon he has traveled 10 miles of corduroy road and has arrived at Lost Pine Lake. By night his camp site has been cleared, his tent is up, a roaring fire is burning under a substantial supper and a balsam couch is ready for the night's big sleep.

Next morning he is up before the sun to take a dip in the lake. Then fried bacon, twist bread, and coffee for breakfast. Afterward the morning's preliminary exploration



THE WRONG WAY
 Sketched by Doctor Crampton



The first day—a bad coat of sunburn



A big appetite—he gorges himself at dinner

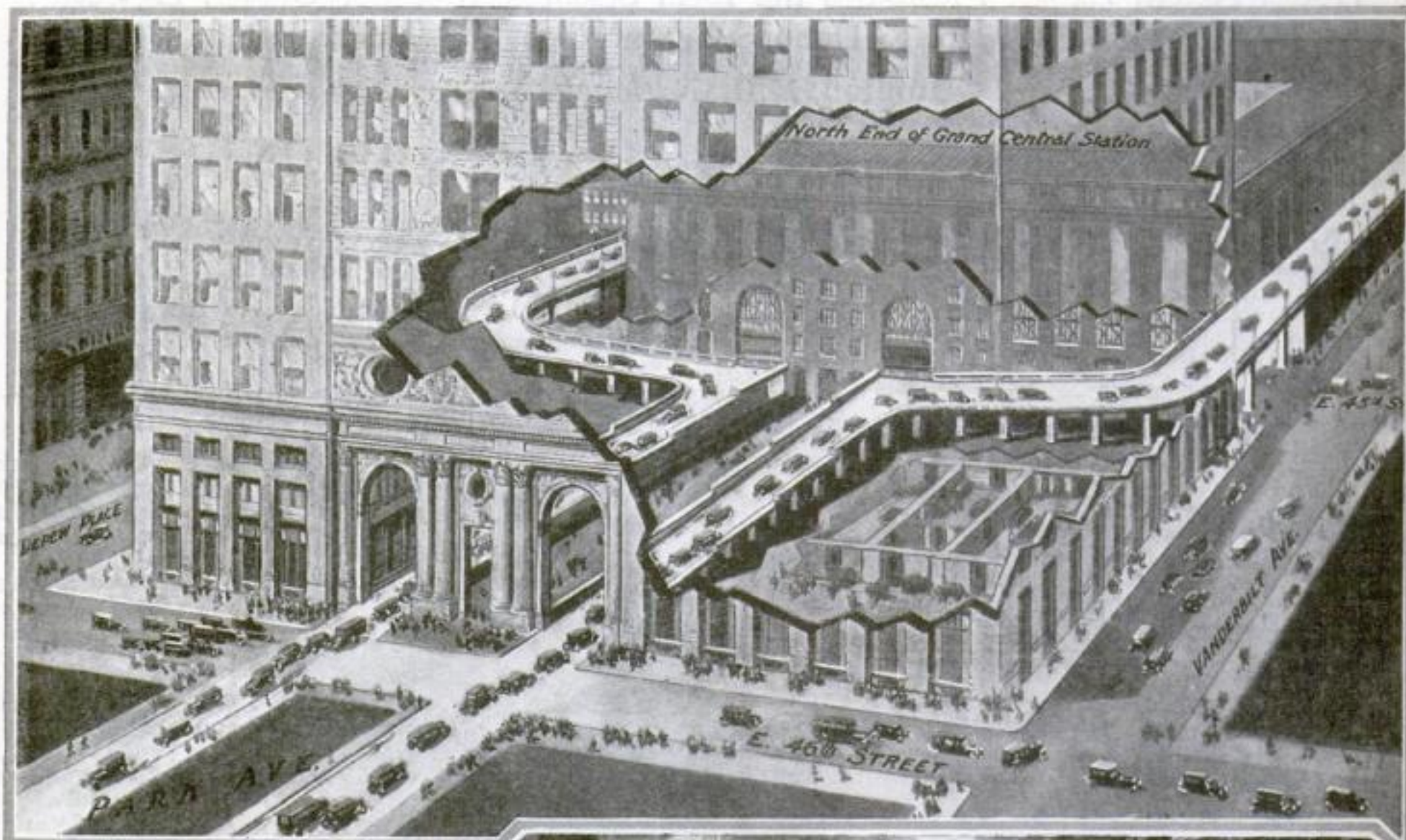


At the casino—he dances until after midnight



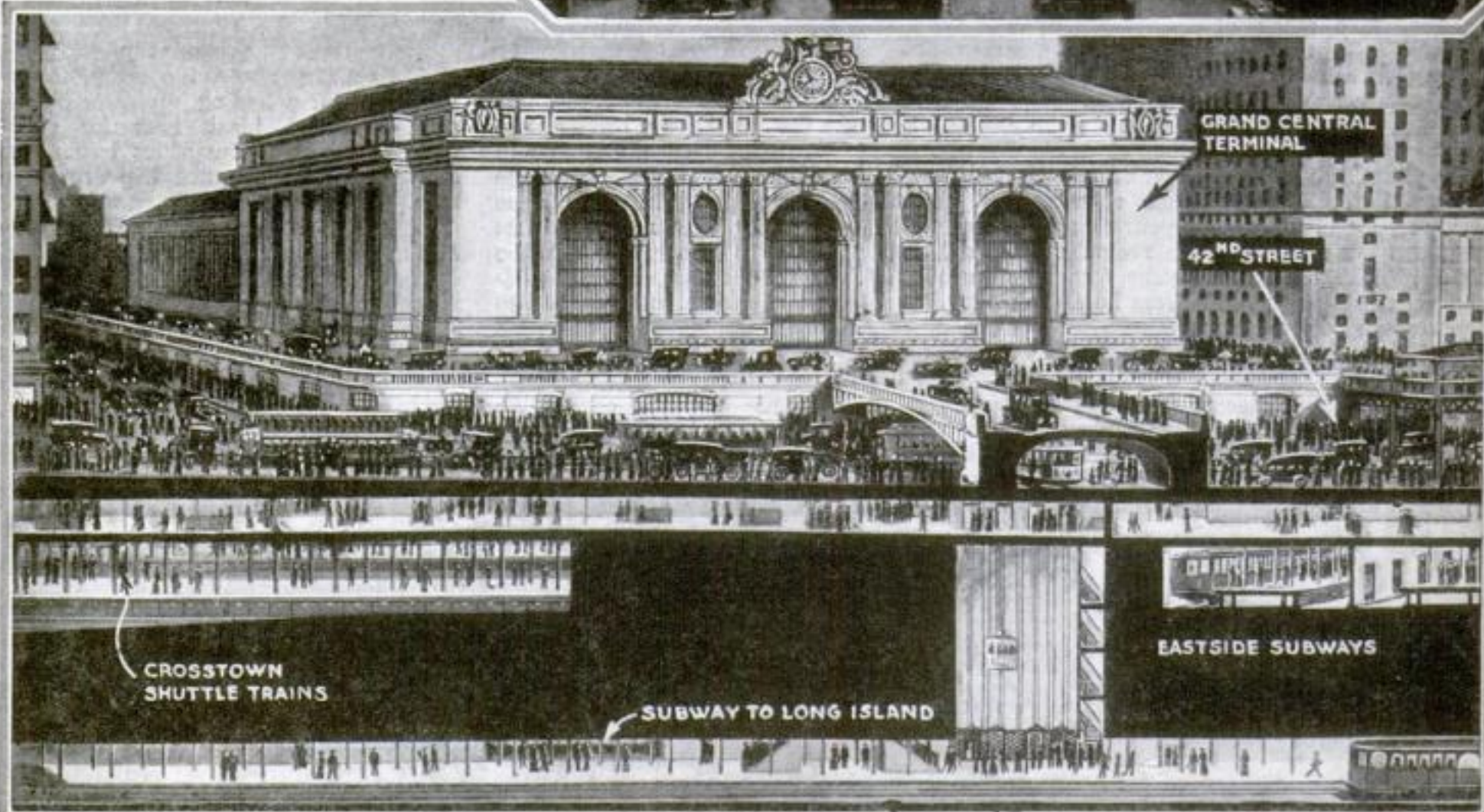
Home again—tuckered out

How New York Seeks Escape



BY RUNNING auto roadways through a huge office building north of Grand Central Terminal, New York plans to carry northbound and southbound traffic around the terminal and over the present viaduct above the congestion of Forty-Second Street.

At the right is a typical jam along Fifth Avenue, a block away. Every 12 hours 20,000 vehicles from every state in the Union pass Forty-Second Street



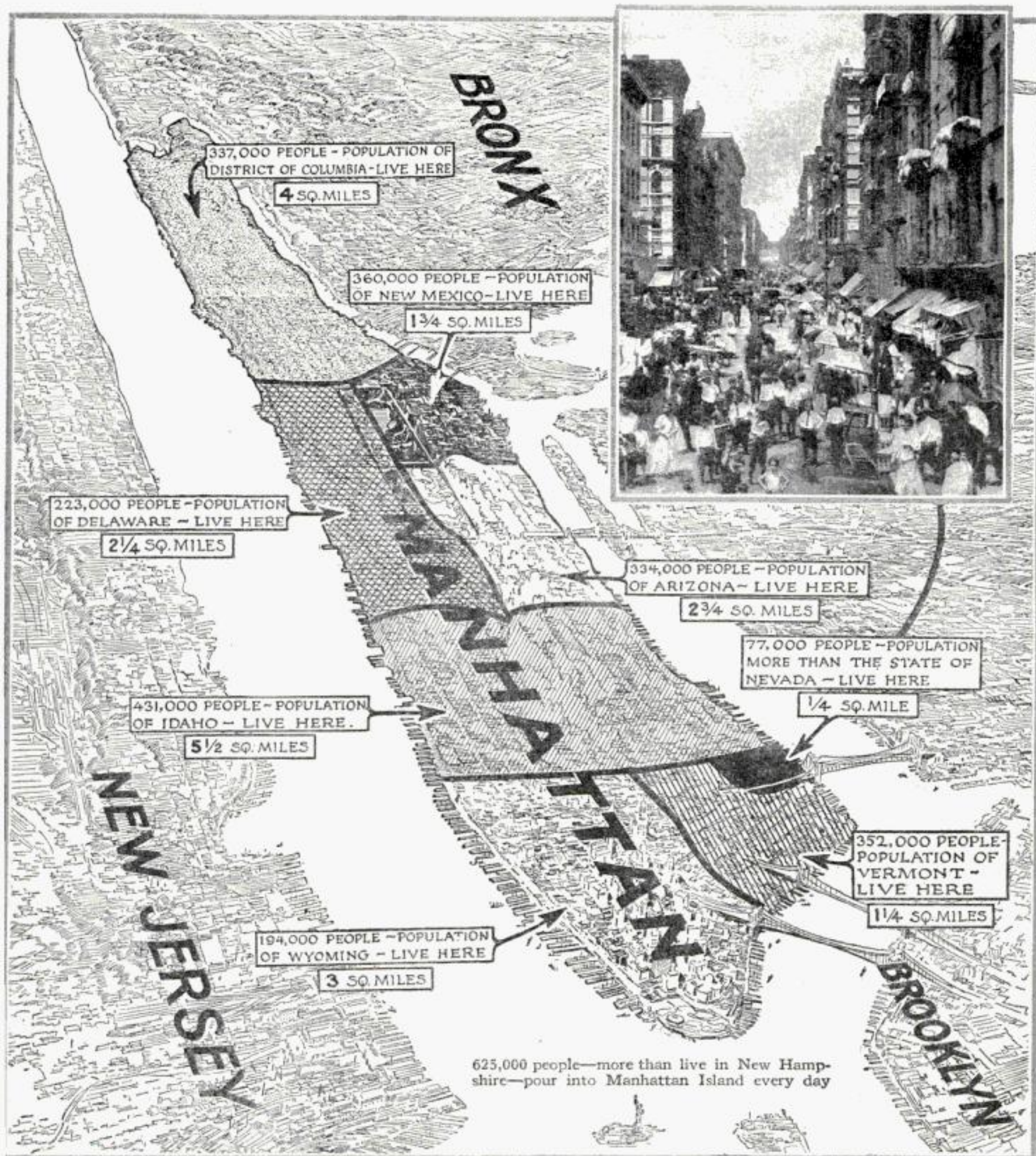
Forty-Second Street at the Grand Central Terminal, showing how the city has burrowed deep and bridged streets, trying

to keep pace with the ever-increasing traffic. At this point are five distinct traffic levels, shown above; yet vehicular traffic, doubling

every 3½ years, has outgrown even these accommodations. Now the city plans to build highways one above the other

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from Deadly Traffic Tangle



CAUGHT in a snarl of traffic congestion unprecedented in the world, New York City is seeking escape from the smother of automobiles, railways, streetcars, and human beings that actually threatens the city's commercial life.

The bird's-eye map of Manhattan Island above shows how 2,300,000 residents—equaling the combined populations of seven states and the District of Columbia—are packed into an area of only 22 square miles. The inset photograph shows a typical view along one of the streets in the most thickly populated section of the East Side.

Yet this resident population of Manhattan, huge as it is, comprises only a comparatively small item in the growing traffic problem. From the New Jersey shore across

the Hudson on the west; from the four boroughs—Brooklyn, Bronx, Queens and Richmond—which, with Manhattan, constitute Greater New York, hundreds of thousands of people and thousands of automobiles are dumped onto this one little island every day by ferries, railroads, bridges, and under-river tubes.

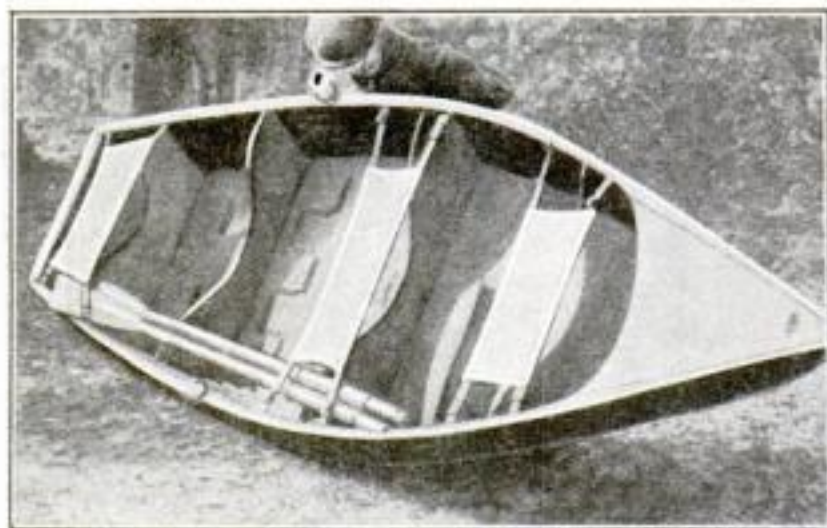
It has been estimated that 228,000,000 people—more than twice the population of the United States—are poured into Manhattan each year. And the flood continues to grow. Each of the four residential boroughs is far larger in area than Manhattan, and in each the population is increasing at a terrific rate. A few short years ago the Bronx was little more than 40 square miles of vacant lots; today it houses nearly 800,000

people. Brooklyn, with an area of 77 square miles, has more than doubled its population in the past 30 years, and now is equal to Manhattan. Queens, which is more than five times as large as Manhattan in area, promises a greater population within the next 20 years.

Thus, from all sides flow the swelling streams of traffic that pile into a jam on the little island of Manhattan. Every day 200,000 automobiles and 25,000 taxicabs ply its streets.

Attempting to keep pace with the deluge, New York City, having already honey-combed the earth beneath the streets, has resorted finally to the plan of building automobile highways one above the other. The first step in the plan is pictured on page 58.

Rowboat for Auto Tourists



At left: Collapsible rowboat ready for service. When knocked down, the boat can be packed in a small box on the running-board, shown below

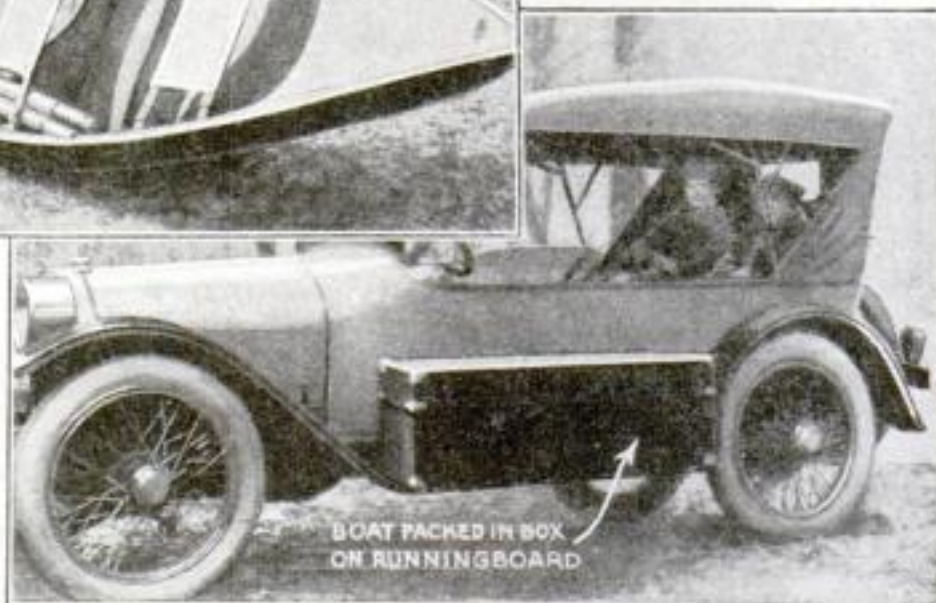
A STURDY, yet collapsible steel and canvas rowboat that can be packed in a box 12 by 18 inches, recently has been perfected for the use of tourist fishermen.

Riding on the runningboard of a touring car, it can be taken along on a summer's week-end trip. It weighs less than 100 pounds and can be assembled in a few minutes.

The boat is built in 21 sections of three-ply laminated boards. They lock together by means of steel fasteners, no bolts or screws being necessary. No tools are needed. All the work can be done by hand.

When the sections have been assembled, a canvas cover is drawn over the frame and tautened by means of straps that also support the canvas seats. The boat is 12 feet over all when assembled.

The stern is solid enough to support a small rowboat motor.



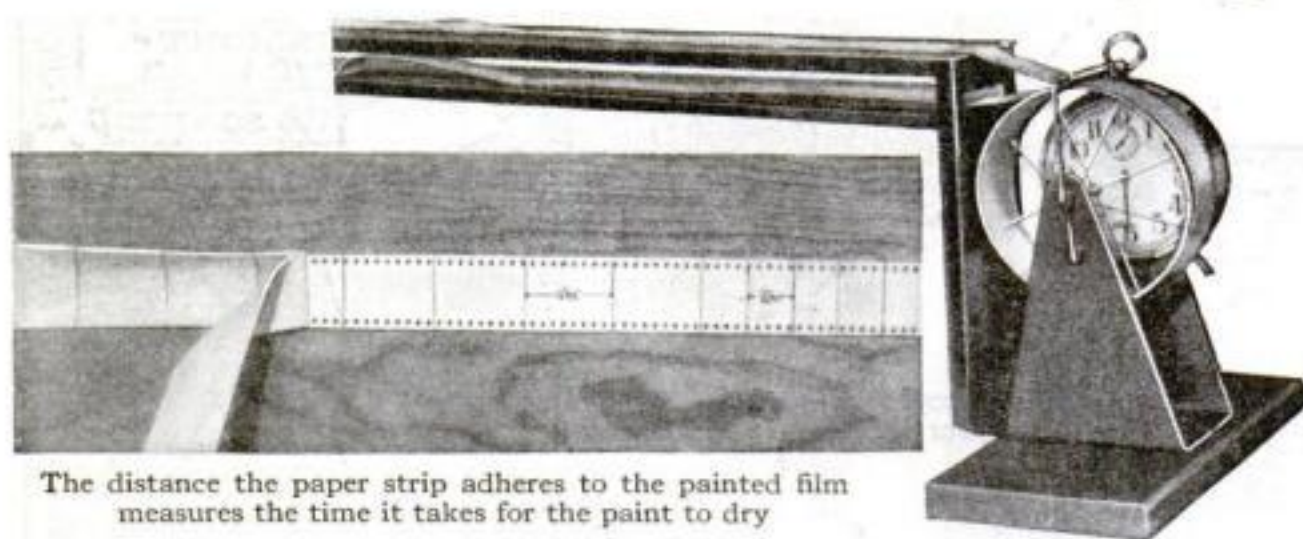
BOAT PACKED IN BOX ON RUNNINGBOARD

Lead and Alcohol Kill Auto Engine Knocks

LEAD is one of the heavyweights and alcohol one of the bantamweights of the chemical world, yet Thomas Midgeley, chemist of the General Motors, has made them join hands amicably to vanquish the "knock" in automobile engines.

The new compound is composed of six parts of ethyl combined with two parts of lead. By adding it to gasoline, a lower grade of that fuel may be used, it is claimed, without the engine knocking about it. Only a few drops are needed to produce the correct results.

Clock Machine Times Paint Drying



The distance the paper strip adheres to the painted film measures the time it takes for the paint to dry

HOW long does it take paint to dry? To answer this question accurately and to test the drying qualities of various paints and oils, Howard A. Gardner, of Washington, D. C., has invented a machine that automatically records the drying time to within a few minutes of absolute accuracy.

The machine consists of an alarm clock, which causes a drum to rotate with the hour hand. Upon this drum is wound a moving-picture film upon which the paint has been applied. Thin tissue paper is drawn into the machine with the painted film and pressed upon the painted surface.

While the paint is wet, the tissue paper is stained; but as soon as the paint dries,

the paper ceases to adhere to the film. An inch on the film indicates an hour of drying. Thus if 24 inches of tissue paper sticks to the film, the particular paint being tested requires 24 hours to dry.

Tapioca from Poison Root

FEW people who enjoy tapioca pudding realize that they are eating a product of the poisonous cassava root. In its natural state this root is extremely bitter and harmful because of the hydrocyanic acid that it contains, but when heated it becomes palatable and its poisonous qualities are readily dissipated.

Golfer's Raincoat Rolls Up to Fit in Bag

RAIN need not bother the golfer who owns one of the new golf bag raincoats. The coat weighs only 15 ounces and can be rolled up and slipped into a golf bag.

Its sleeves are short and loose to avoid interference with free action of the arms. Attached to the coat is a rubber hood that fits tightly over the head and keeps the rain from running down the golfer's neck.



The raincoat as worn by golfer

Inset shows coat rolled in bundle

New Level Hangs on Line

A NEW level for use in laying foundations, tile pipe, cement and brick walls and for other construction jobs, recently has been placed on the market by a concern



in Athol, Mass. Weighing only half an ounce, this level can be hooked over a line stretched between two points to determine the levelness of surfaces that are to be rough for surface levels.

A luminous level glass with a yellowish fluid facilitates readings.

Arm-Mobile Newest Type of Kiddie Car

THE "arm-mobile" is a novelty in kiddie cars, recently invented by a resident of Oakland, California.

Two arms, each fastened off center to one of the rear wheels, are hinged together at the front end to a curved bar that swings on a pin under the front of the car. "Rowing" backward and forward turns the rear wheels and propels the car.



Propelling the car in rowboat style



Scientists X-Ray Mummy to Study Evolution

THE first X-ray pictures ever taken of a mummy were recently completed by scientists at the American Museum of Natural History, New York City. The pictures showing the skeleton in detail are expected to be a great aid in studying the development of bone formations in the evolution of man. The first subject of the scientists' X-ray was a South American Indian mummy.

Water in Paper Bag Can Be Heated over Flame

IN SMALL town hotels where hot water is not available for shaving, traveling men sometimes fill a paper bag with water

© K. & H.



Boiling water in a paper bag

and hold it over a lighted gas jet. They now know that the heat from the flame, traveling upward, will heat the water and will keep the bag dry without burning it.

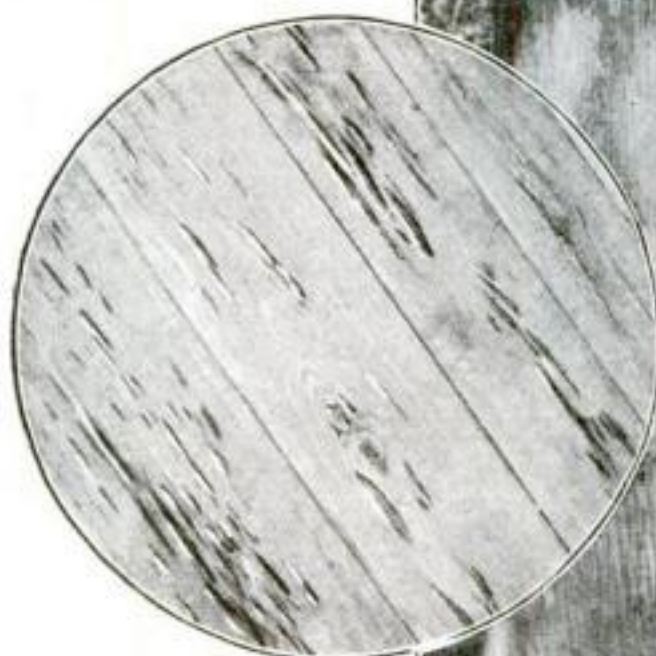
A New Chemical Element

TWO Danish scientists, Dr. G. Hevesy and Dr. D. Coster, working at the University of Copenhagen, have announced the discovery of a new chemical element which they call "hafnium."

Hafnium was discovered by means of an X-ray spectrum. It occupies, the Danish scientists believe, one of the six vacant places long known to exist in the list of the chemical elements.

Strange to say, this latest recruit among the chemical elements seems to be quite common in the world. Doctors Hevesy and Coster think there is more of it in the earth's crust than there is of gold.

Cypress Vaccinates Itself



AGES before Dr. Edward Jenner discovered how to make us immune from smallpox by vaccination, the long-living and prolific cypress tree used practically the same method to procure immunity from rot. This astonishing fact was discovered recently through scientific study of the most famous trees in history.

Cypress trees are numbered among the oldest living things on earth. The age of one tree in Louisiana is estimated at 2500 years—its life was just beginning when Nebuchadnezzar captured Jerusalem.

This long life is largely due, scientists say, to the fact that the trees manufacture their own preservatives. The majority of cypresses suffer from a sort of vegetable smallpox. "Pock marks" similar to those that appear on human smallpox victims, develop as blemishes in their wood.

The disease is caused by a fungus that penetrates the tree through broken

branches, dead tops, or decaying knots. These holes fill with a brown powder.

Strange to say, this powder acts as an antiseptic that finally kills its parent fungus and ends the disease. Further, the powder is absorbed by the sap of the tree and acts as a general preservative, immunizing it from rot.

A group of giant cypress trees, showing strange anchoring roots. Inset shows typical "pock marks" in cypress

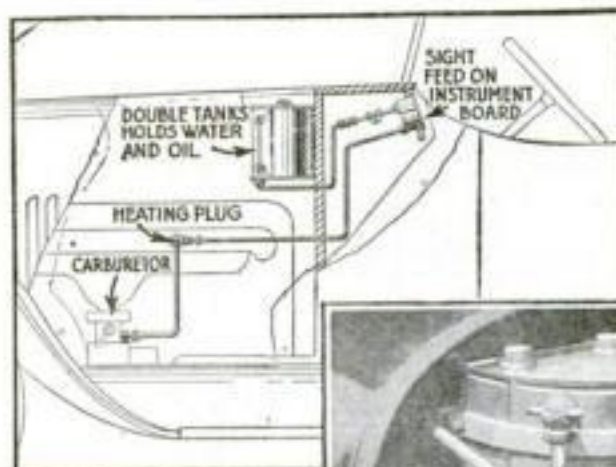


New Gasoline Vaporizer Uses Steam

ON THE principle that superheated steam breaks down carbon, Dr. K. A. Mayers, of San Antonio, Texas, has invented a volatilator for gasoline engines which, he claims, increases the engine's power, prevents carbon deposits, and provides a lubricant to the moving pistons.

The device consists of a copper tank fastened to the dashboard, a sight feed, a heating plug, and pipe line system. The tank contains oil and distilled water, which flows through a sight feed in front of the driver. From here the oil and water mixture is conducted to a heat-

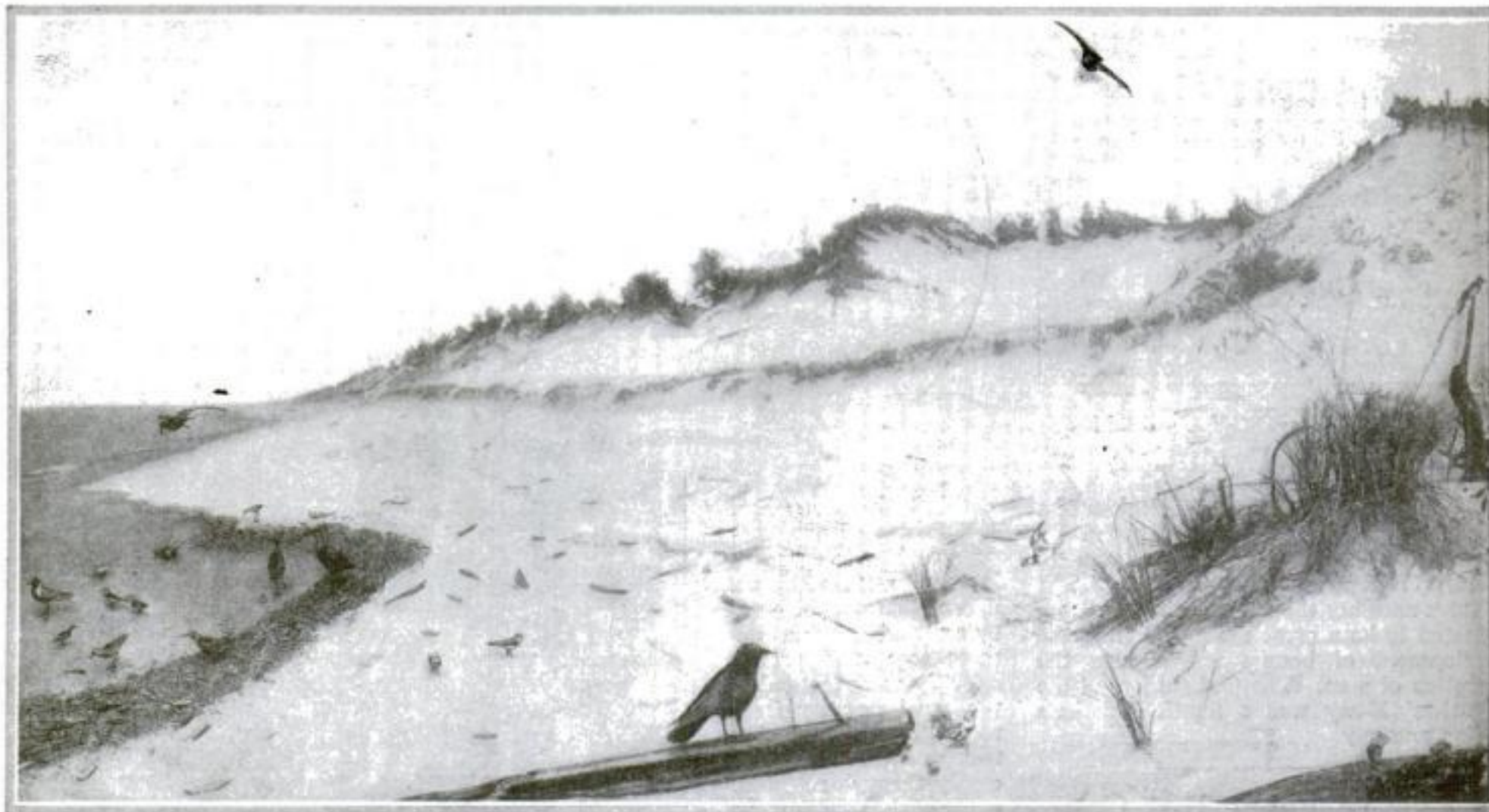
ing plug on the exhaust manifold. At this point the water is converted to superheated steam, the oil is vaporized, and the mixture is admitted to the carburetor, where it is mixed with gasoline before being admitted to the cylinders.



Operation of this new volatilator, attached under the auto hood, is shown in the diagram



World's Largest Photograph



Here is a portion of the world's largest photograph, 96 feet long and 10 feet high, in the Academy of Sciences, Chicago. It forms the background of a display showing a panorama of the Lake Michigan shore near Gary, Ind., and the famous Indiana sand dunes

New Safety Locknut Held by Pronged Pin

A RECENT innovation in safety lock-nuts marks an improvement over existing types in that it can be applied to an ordinary bolt without a cotterpin hole.



In the upper surface of the nut is a depression into which fits a two-pronged forked pin. The inner sides of the two pin points are sharpened to fit into the bolt threads.

When the nut is screwed down as far as it will go, the pin is driven into the slot and the points are then bent around the bolt. In this way the nut and bolt threads are pressed tightly together, holding the nut firmly. To remove the nut, the operation is reversed. A hole in the butt end of the pin provides a means of pulling it out.

A Homemade Seed Tester

FROM an ordinary dinner plate and two pieces of blotting paper any backyard gardener can make a simple and effective seed tester at home.

Cut the papers so that they fit the plate, one on top of the other. Then pour on enough water to wet both papers thoroughly. Now place from 10 to 50 seeds between the sheets of paper. Keep the plate in ordinary room temperature and the papers moist. If the seeds do not sprout, they are sterile and you should obtain a new supply.



New Belts to Straighten Postman's Shoulders

ALMOST any morning now you may meet the mail carrier dressed up in a modified Sam Brown belt. And instead of hunching up his left shoulder that bears the sack, he will be walking upright.

The right shoulder of almost every mail carrier is about an inch lower than the left, due to the weight of the mail sack, carried on the left side.

It is to correct this tendency that the Post Office Department is experimenting with two belts. One has a strap around the waist with hooks to support the bag. The other has a strap over the right shoulder, to distribute the load.

Life of Building Is from 25 to 100 Years

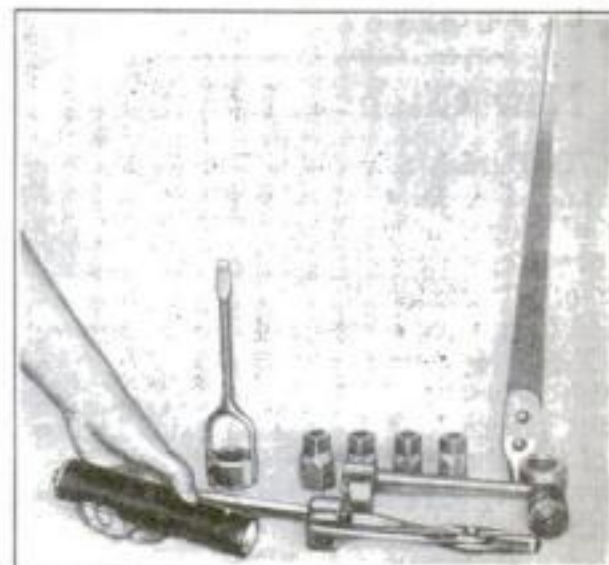
HOW long will a building last? For the guidance of property owners who are not sure how much to charge for depreciation in figuring taxes, the Federal Internal Revenue Bureau gives the following:

"The average usual life of a frame building is 25 years, a brick building 35 years, and a stone or concrete building from 50 to 100 years."

Flashlight Tool Handle for Auto Repairs

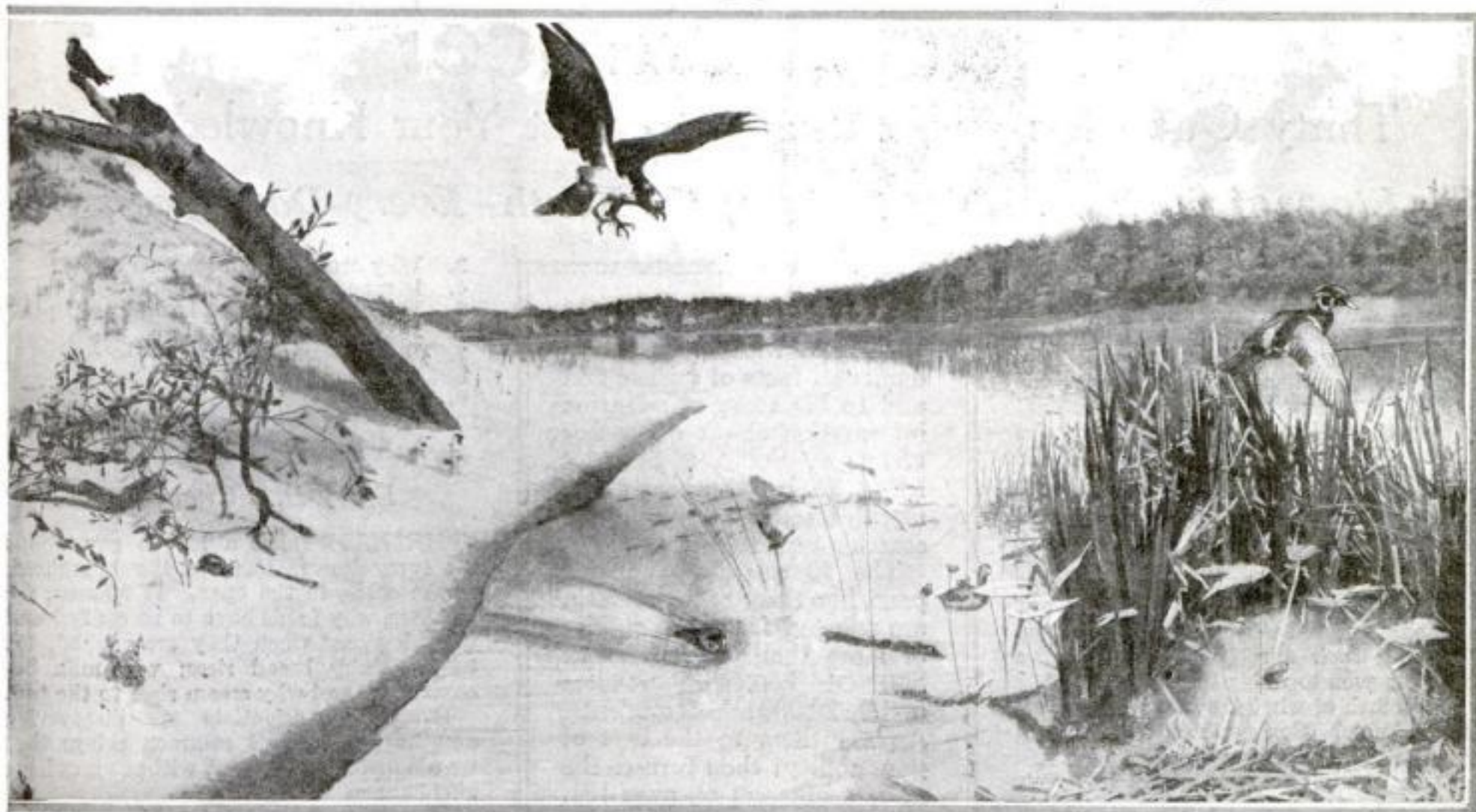
TO FACILITATE working with tools in the dark, a useful flashlight handle that will hold a wide variety of tools has been designed especially for automobile owners. The flashlight is so placed that it throws its beams directly upon the work.

The handle screws into the sockets attached to each tool.



The flashlight handle and variety of tools that can be attached

Nearly as Long as a City Lot



This huge picture was made by Dr. Frank M. Woodruff, curator of the Academy, who declares that the photographic background is more accurate and scientific for purposes of display than the oil painting method, while it costs less than one tenth as much

New Vest Pocket Radio Set Has 100-Mile Range

NEARLY every radio fan has seen many of the commercial and homemade "smallest" sets that have appeared from time to time, often taking the form of the crystal set that fits into a pocketbook. Most of these sets, however, have been of the freak variety, with a receiving range usually limited to about five or 10 miles at most. They serve as an introduction to the fascinations of radio, leading the fan to larger sets.



The compact vacuum tube radio set

A new set of the vest pocket variety, embodying the essential features of long range sets, uses a combination of crystal and vacuum tube detector. It can be operated with or without batteries and has an effective range of from 50 to 100 miles. In spite of its small size, the popular and efficient three-circuit hook-up is used, with spider-web coils for the primary, secondary, and tickler inductances. Rough tuning of the primary circuit is accomplished by a three-point switch, while the finer tuning of the set is accomplished by varying the inductive relationship of the three coils.

These intricate features are embodied in a remarkably compact instrument, little larger than a man's hand.



Power Lawnmower Made from Cultivator Frame

A CULTIVATOR frame with gasoline engine has been converted into a power lawnmower by an Ohio concern. A 30-inch lawnmower is attached to the frame of the cultivator by means of special fastenings. When the small gasoline engine is running and the clutch is thrown in, the mower is guided with little exertion on the part of the operator.

When an obstruction is encountered, such as a walk, the operator depresses the handles. This raises the cutting blades while the cultivator continues to move forward. When the obstruction has been passed, the blades are lowered again by raising the handles.

The ingenious machine is especially adapted for use on golf courses.

Lifelike Toupées Now Are Spun from Glass

HAIR spun from glass is now being used by German wigmakers in manufacturing lifelike toupées. They claim that glass hair is the most effective substitute for real hair yet devised, defying detection.

The glass wigs are said to be light in weight. Curls and waves can be produced, and the color won't run.

Telescope and Binoculars in One Instrument

A FIELD glass provided with an auxiliary lens for astronomical observations has been perfected recently for use in near and far vision.

The auxiliary lens is contained in a cylindrical tube attached to the front of the binoculars. This closes off one of the eyepieces and directs all rays to the other eye. In this way the glass is used in observing the stars.



The binoculars with telescope attached

How Much Do You Know about Science?

Thirty Questions and Answers to Test Your Knowledge

The Story of the Stars—The Story of the Earth—Every-Day Chemistry

Answers to the questions asked in this article are published on page 101

THE questions this month begin with the Story of the Stars.

Did you know that the sun was the only star in our solar system? The "stars" that most people know best are really the planets—Venus, Mars, Jupiter, and the rest. They are so far off that it takes thousands of years for light from them to reach us, and light travels at the rate of nearly 200,000 miles a second. Yet modern astronomers, with their long range telescopes, have been able to reach out into space and tell what the stars are made of. With their spectroscopes they have been able even to weigh the stars.

How much of what they have found out do you know? Can you read the heavens or is it all still a mystery to you?

These questions will help you test your knowledge.

The Story of the Stars

1. How large is the universe?
2. Why do the stars twinkle?
3. Are the stars solid?
4. Why do stars appear to be pointed?
5. Can the future be told by stars?
6. What causes an eclipse of the sun?
7. Why does the sun shine?
8. Why does the moon shine?
9. What is the moon made of?
10. What would happen if the earth collided with a star?

The Story of the Earth

FOUR or five billion years ago the earth was formed. Since then a great many things have happened to the earth and science has been able to read the record of most of these happenings, at least from the first appearance of life in the fossils left in rocks.

TO HELP every reader test his knowledge of the fundamental facts of science and add to his store of scientific information about every-day things, POPULAR SCIENCE MONTHLY is publishing every month a series of simple, yet searching questions.

The 30 questions on this page, like those of last month, are selected from the queries of more than 6000 POPULAR SCIENCE MONTHLY readers and by 20,000 school students. Answer them to the best of your ability; then turn to the correct answers on page 101. Grade yourself 10 points for each question answered correctly, and see how near you come to a 100 per cent score for each classification.

The six or eight thousand years of known human history are no more than a moment in the history of the world. Science had to go far beyond the earliest human history to find the reasons for such commonplace things as the soil of our fields, the water in our lakes and rivers, the sand on the beach, the vegetation that covers the earth, the animals we use and eat and, most important of all, the origin of man. See how much of this knowledge you have acquired.

1. How do we know the earth is round?
2. Is the inside of the earth molten?

3. Why are stones in streams round?
4. Is man related to the monkey?
5. What is the greatest known sea depth?
6. What is air composed of?
7. What causes the wind?
8. What causes rain?
9. What causes snow?
10. Why is frost more likely on a clear night than on a cloudy one?

Every-Day Chemistry

CHEMISTRY has a lot to say about every-day matters in the household, in the office, in the open. It tells us, for instance, why foods have to be cooked and what happens when they are cooked. It tells us why bread rises; why milk becomes sour and why cream rises to the top.

Every day scientists are discovering amazing facts about common things that we are inclined to accept without inquiring about them.

Your silver becomes tarnished and you spend hours rubbing and polishing it without, perhaps, knowing what made it tarnish. Chemistry will tell you. Chemistry also will give you the reasons for thousands of things that happen every day.

How much do you know about this fascinating subject? These 10 questions will test your knowledge.

1. What is fire?
2. What makes automobiles smoke?
3. Why does iron rust?
4. What test distinguishes wool from cotton?
5. Why does milk turn sour?
6. Why does yeast make bread rise?
7. Why does bluing bleach clothes?
8. Do thunderstorms turn milk sour?
9. Why is salt lumpy in wet weather?
10. Why does silver turn black?

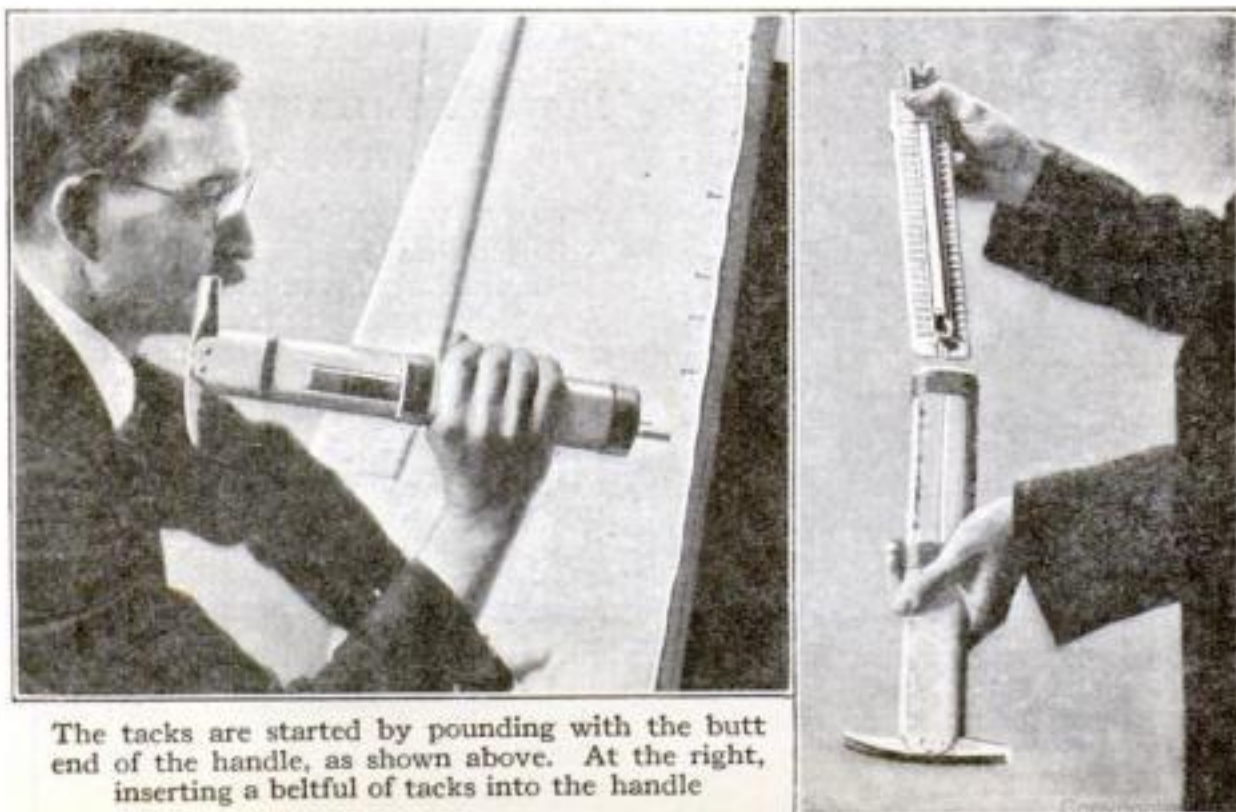
Next month—Electricity and Radio—What Is Life?—The Story of the Mind

Self-Feeding Hammer Drives Four Tacks a Second

WITH a self-feeding tack hammer recently invented, one can tack placards and decorations without paying the usual price of bruised fingers. Tacks are contained in the handle of the hammer and need not be handled by the person driving them.

An endless fabric belt to which 70 tacks are glued, runs inside of the handle from the butt of the hammer to the head. The tacks are automatically fed, one by one, into a device, which projects them, one at a time, point outward, at the butt end of the handle. When the supply of tacks is exhausted, the old belt can be replaced by a new one, as shown in the illustration at the extreme right.

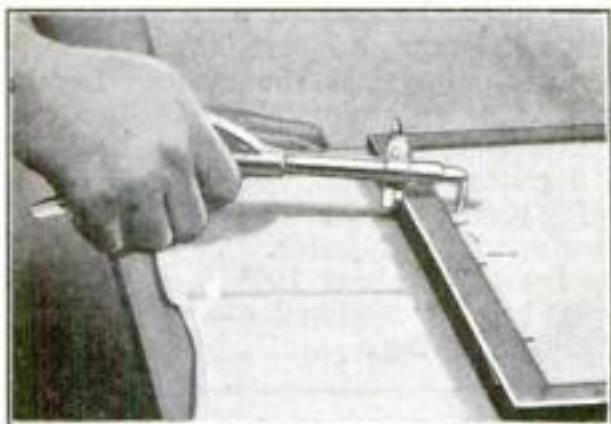
The operator, striking with the handle butt on the spot where he wishes to drive a tack, starts the tack in the wood and loosens it from the belt. The tack is then driven in the usual manner. It is said that more than four tacks a second may be driven with this hammer.



The tacks are started by pounding with the butt end of the handle, as shown above. At the right, inserting a beltful of tacks into the handle

Small Grip Tool Drives Nails by Pressure

A POWERFUL little tool for driving nails and tacks in inaccessible places has been designed especially for upholsterers and picture-framers. The tool drives



nails by means of forceps that are brought together by pressure on grips at the handle. It eliminates the danger of breaking glass or marring fine furniture with a hammer.

Cardboard as Disk Cutter

A DISK cut from a strong piece of cardboard and attached by a string to the wheel of a sewing machine can be made to serve as a perfect rotary disk cutter.

By giving the disk a high speed, it is possible even to cut a pencil in pieces.

Simple New Envelope Sealer Is Clamped to Desk

AN INEXPENSIVE envelope sealer that can be clamped to any desk or table is one of the newest office accessories on the market. The machine is made entirely of metal and has only one moving part.

The envelope is sealed by first passing the flap between a moistening roller and a spring made of strips of nicked silver, then pulling it through another set of springs, which seal it securely.

The roller is made of aluminum. It is easy to clean and always sanitary. All



How the machine seals envelopes

izes and shapes of envelopes can be sealed with the device. It also will moisten gummed tags, labels, and stickers.

City Directory Works Automatically

TO ASSIST strangers in locating municipal buildings, railroad stations, or business houses, an automatic city directory recently has been installed in Miami, Fla. The apparatus consists of a large map of the city and a printed list of buildings and stores. When the inquirer presses a button alongside the name of the firm or building he wishes to locate, a red light flashes the location on the map. A green light shows the present location of the person who presses the button. A white light shows where the streetcar is to be taken in order to reach that destination and a blue light indicates a point of transfer.

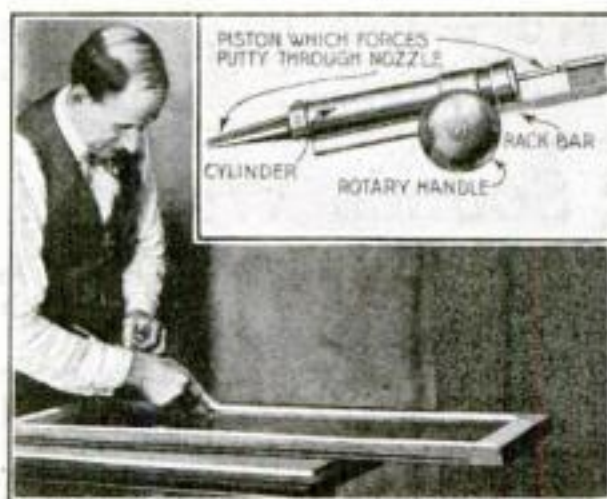
The various places are listed under



Lights point the way when a button is pressed

separate headings, such as Hotels, Depots, Subways, and Stores, so that, by looking under its correct class heading, any place can readily be located.

Piston Tool Applies Putty Quickly



Puttying window frame with new tool

A HANDY tool for evenly and quickly applying putty has been invented by Charles H. Weber, of Columbus, Ohio. It consists of a cylinder and piston, the outer end of the piston being attached to a rack bar that is in mesh with a pinion attached to a rotary handle.

The piston forces the putty through a tapering nozzle. The top plate of this nozzle is bent at the outer end to provide a small tamping member for pressing down the putty.

The new invention is designed to feed the putty in exactly the right quantities, and to eliminate the usual soiling of the workman's hands when applying putty with a knife.

Molding Book Ends and Toys of Wax

ORDINARY wax or sealing-wax now may be utilized by any woman in decorating the home or in entertaining the children, through the perfection of a new molding process by a Chicago inventor.

Molds for paperweights, book ends, and various animal toys have been put on the market with complete directions as to their use.

In making children's toys, the molds are first cooled with water. Melted wax is poured in both sides of the mold. The sides are then held together by rubber bands until the wax sets. After being placed in an icebox to cool for a few moments, the

molds can be lifted off, leaving a complete wax statuette. A complete zoo can be made in this manner.

The process is so simple that a child can make his own animals. The child should be cautioned, however, not to burn itself. The wax can be used many times and there is no end to the game's fascination.

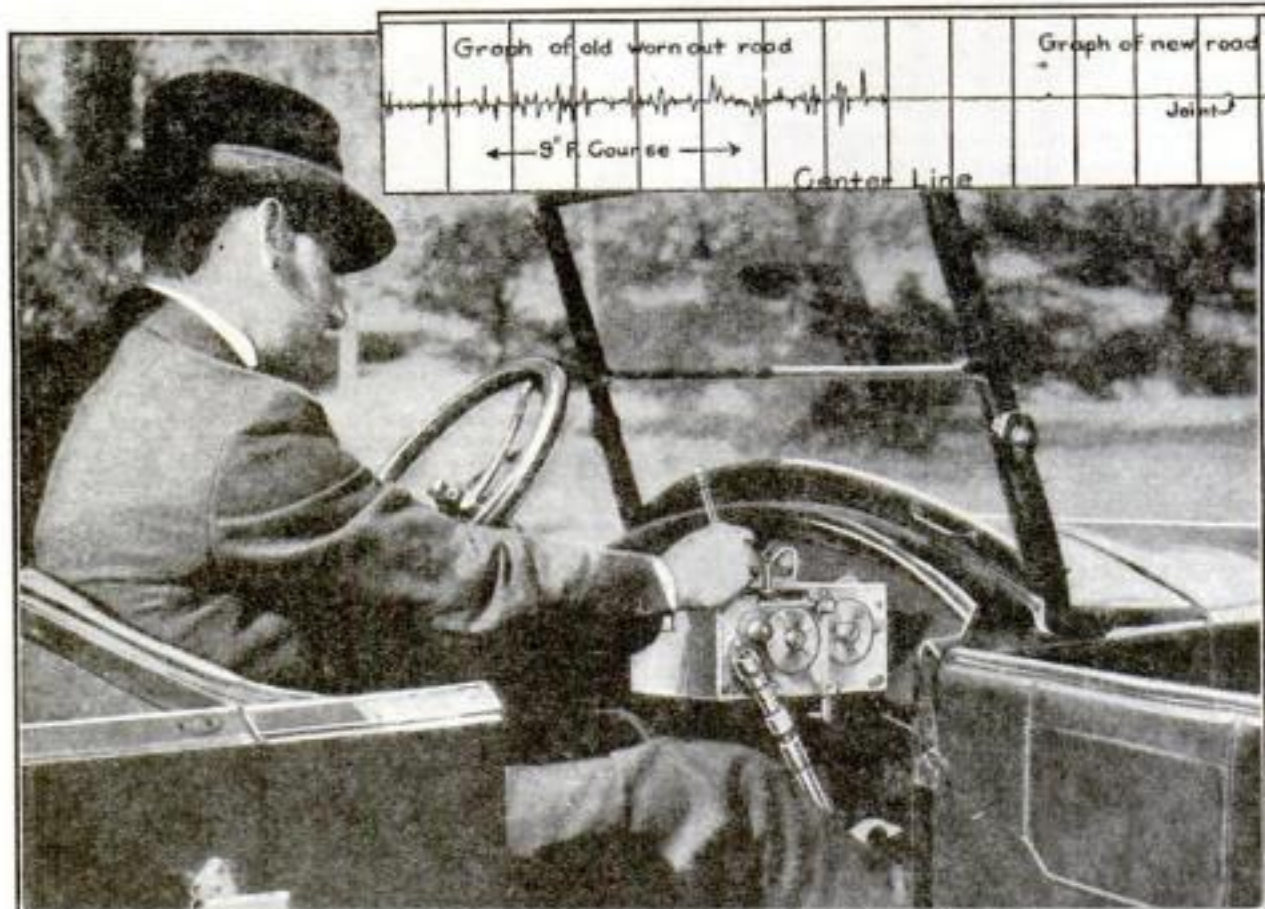
For making book ends and paperweights the same process is used, except that

sealing-wax is substituted for ordinary wax and the molds are larger. Lead bases are furnished to give the required weight. A little more care in finishing is needed in making these.



Typical animals and book ends molded from wax melted as shown above

Auto Charts Road Surfaces



INSTEAD of inspecting a road surface to see where it needs repairs, the up-to-date highway engineer now can drive over the road in a car equipped with an ingenious new instrument that automatically charts the road surface.

The machine, of aluminum, is mounted on the dashboard. Connected with one

of the front wheels of the car is a shaft that drives a strip of paper six inches wide through the recording instrument. Two recording pencils are actuated through connection with the front axle.

As the car travels, the chart moves at the rate of one inch for 50 feet of road, while the pencils mark the chart.

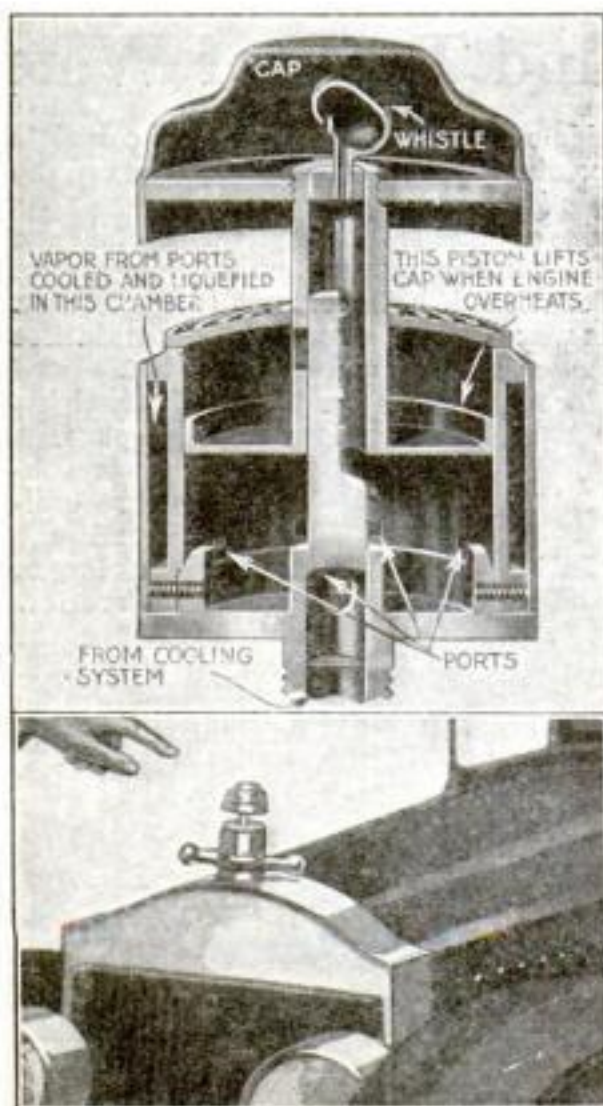
Overheated Radiator Sounds Warning

AN UNUSUAL alarm recently perfected serves the double purpose of condensing the vapors generated in the radiator and of signaling by whistling and exposing a red disk whenever the water becomes too hot.

The alarm is fastened to the radiator in place of the usual cap. Water vapors pass up

through a central port into a chamber, where they are liquefied by coming in contact with the cool outer walls of the chamber.

If the heat rises above 190 degrees, the pressure increases, raising a piston fastened to the top cap, and exposing the red surface of the chamber. This signifies something wrong. A further increase in pressure will raise the piston still higher, permitting the gases to enter a port on the hollow piston and to pass through a whistle in the cap that signals great danger. Should the water continue to heat up, the cap will be raised and the steam will escape.

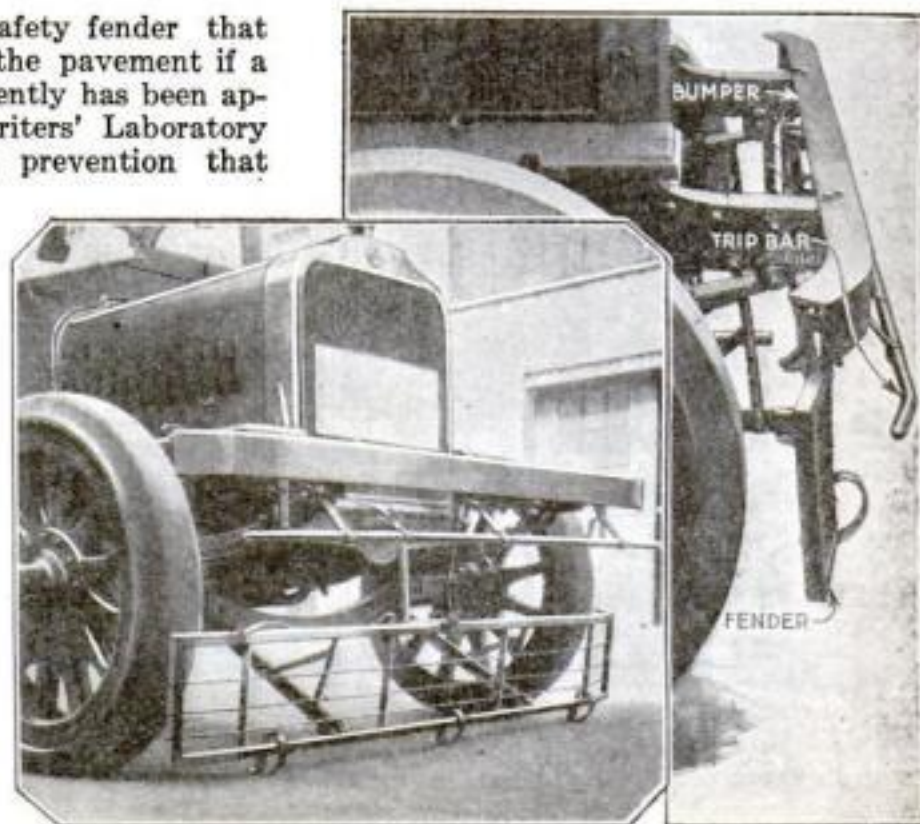


The signal cap and its mechanism

Safety Fender Safeguards Lives

A NEW automatic safety fender that drops instantly to the pavement if a car strikes a person, recently has been approved by the Underwriters' Laboratory as a valuable accident prevention that will save many lives.

The fender consists of a bumper, a horizontal trip bar, and an automatic screen. The trip bar is placed an inch or two in front of the fender and extends from one front wheel to the other. The instant a person is struck, it releases the fender, which drops to the ground and prevents the person from being crushed. Meanwhile the driver has his hands free to stop the vehicle as quickly as possible.



A blow on the trip bar automatically drops the fender

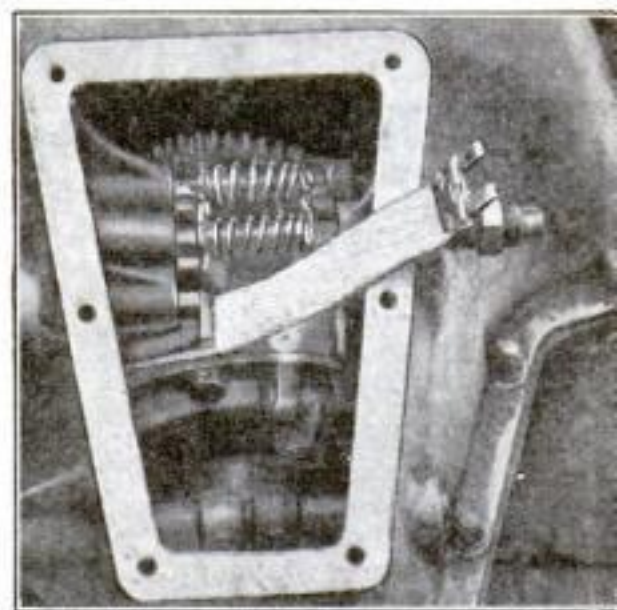
Auto Engines Cleaned by Air Pressure

DEPOSITS of oil and dirt can be readily cleaned from automobile engines and frames by air pressure. The apparatus consists of a long nozzle through which a mixture of air, oil, and water is sprayed on the part to be cleaned at a pressure of about 90 pounds a square inch. The spray is directed against the surface from a distance of approximately 18 inches.

One gallon of oil is used with about 300 gallons of water, the correct mixture being produced by mixing valves attached to a special oil injector. The water must be heated to about 100° F., and the oil must be a light-colored gas or petroleum distillate having a paraffin base.

New Transmission Linings Save Repair Bills

FORD owners will be interested in a new quick change transmission lining, which is said to save time and repair bills. The



How the new lining is inserted

lining can be installed easily without changing the construction of the car.

In changing the lining, it is necessary only to remove the plate on the transmission cover, slip out the worn linings and slip in the new ones. The three linings can be changed in half an hour by one man.

Gypsyng de Luxe by Auto

Whole Nation Is a Playground for Summer Tourists; How to Make the Auto Trip Successful

By Harold F. Blanchard

AT LEAST a million people are going auto-camping this summer.

Only a few years ago the fascinating summer sport of "camping out" was limited to a very few vacationists who were willing to "rough it"—to put up with its inconveniences and even its hardships. Today the automobile, with its constantly increasing number of new accessories providing home comforts, has brought the joy of the open road and the wooded places within reach of every one.

Auto-camping has become the national summer pastime. Last year more than 1200 public camp grounds were in use. This year the number is well over 2000.

For the auto-camper, the whole United States is available as a summer resort. There is hardly a town in the country where he cannot camp. No longer is the vacationist tied to one spot along the shore, lakeside, or in the mountains. Such things as reservations, high prices, and neighbors mean little to him. He rambles where he will and halts according to his whim. In his car he has found the nearest approach to absolute freedom and contentment during his vacation days.

And not only has automobile camping proved to be a delightful way to spend a vacation, but an economical way as well. Compared with other forms of outing, the initial expense and the running expense are small. A modest camping outfit may be assembled for less than \$100. There is a satisfactory, practical, durable outfit to fit every pocketbook.

I am assuming, of course, that the prospective auto-camper already owns a car. If not, there are plenty of small but serviceable used cars to be had for \$200. And right here I suggest to the man who has no need for a car through the winter months that he buy a used car for his camping trip and sell it when he gets home. If he pays \$200 for a secondhand automobile, he should be able to dispose of it for \$150 or \$175.

PREPARING CAR

FIRST of all, to avoid mechanical trouble on the trip, the car should be carefully inspected and repaired. Be sure that the carbon is removed, the valves are

ground, the breaker points properly adjusted, the lubrication system is clean, the clutch in adjustment, and transmission and rear axle in good condition and lubricated. Wheels, universals, and steering gear should be lubricated, brakes adjusted, and a spare fanbelt taken aboard. Tires should be examined and spares purchased if necessary. Finally, all nuts should be tightened, including those holding the electric wires.

Provided the engine bearings are in adjustment, the engine is not likely to break down unless the lubrication fails. The clutch should not give any trouble if it is in good working order at the start. Transmission and rear axle are hidden parts, and if their inspection covers have not been removed for some time, it is a good plan to remove them just to make sure there are no parts so nearly worn out that



Loaded to the springs. Here's the way auto-camping used to be done. Nowadays everything—from bed to boat—folds into neat little bundles that fit in a box. Yet this oldtimer has seen lots of fun. It has traveled 200,000 miles and is still good for more. The queer top, when removed, serves as a boat

they are likely to break at some critical moment of the tour.

It Pays To Be Prepared

It is inexcusable folly to have something go wrong 50 miles from nowhere, and then wish vainly that you had purchased some badly needed gadget before you started. A collapsible bucket, for example, is almost indispensable if the engine overheats and the water boils away. An extra gallon or so of oil and five gallons of gasoline are other factors of safety.

The car certainly should have a set of chains. Mudhooks, too, will be found useful, for with them it is possible to walk the car out of almost any mud hole. A tow-rope is another useful piece of equipment, and there have been times, too, when a block and tackle have come in handy. At least one pocket flash-lamp is essential, plus some extra batteries and bulbs. If possible, every member of the party should have a flash-lamp.

The car should receive systematic care during the trip. Every morning, without exception, a certain routine should be followed. Gasoline tank, oil reservoir, and radiator should be inspected to see that they are full. It does not pay to guess that you have enough gasoline or oil or water. The tires, including the spares, should be examined. Any tires requiring inflation should be attended to at the first garage.

All grease cups should be given a turn or two, and any empty ones should be filled. All oil holes on the chassis should be given a few drops each. If the camping trip is an extended one, remember that universals should be refilled every 3000 miles, and that it is also good policy to lubricate the transmission and rear axle, steering gear, and wheels at this time. The valves on most cars will re-



In Nature's beauty parlor the morning wash is a real joy, especially when the front door of the old flivver serves as a hinged dressing box to hold the complete clean-up outfit, which includes mirror, washbowl, soapbox, two brushes, and a place for towels

quire grinding every 3000 to 5000 miles.

I am convinced that best results are obtained by changing the engine oil every 500 miles. It means more power and better engine wear.

HOW MUCH WILL IT COST?

I HAVE known auto-campers to get along comfortably on as little as a dollar a day a person, including all expenses except tires and depreciation. Compare that with an automobile trip from hotel to hotel! In the usual run of hotels the costs average \$10 a day even if economy is practised; and without care the figure is likely to be \$15.

But with the auto-camper, expenses are limited largely to gasoline, oil, minor repairs, and a weekly grocery and meat bill such as he has at home. If about \$20 is spent weekly on these items at home, it is probable that on the road costs will be about the same.

Trimming the budget to a dollar a day is difficult but possible. There is no question, however, that expenses can be kept down to \$15 or \$25 a week for each person. The amount varies, of course, according to the sum spent for amusements and incidentals, such as camera supplies, fishing tackle, and shotgun shells.

WHERE SHALL I GO?

GET a complete change of scenery, that's my advice. If your home is inland and you love the water, try the ocean or the Great Lakes. If you live on the plains, find some hills or mountains.

Good roads, today, are to be found almost everywhere. It is always well to remember, however, that a poor road at 30 miles an hour is often a splendid road at 15 miles. In fact, I have found that, as a rule, the 15-mile-an-hour roads are more interesting because they are less traveled.

On the side roads the view is rarely blocked by a car ahead, and then these less traveled roads are more apt to offer attractive camp sites and better fishing and bathing. I prefer to take the roads as they come; but when I have a choice, I pick the lower road.

In planning a trip, it is well to be sure that the average daily mileage will be not too high. For most of us, 100 miles a day should be the maximum; 75 miles is better. Much of the possible auto-camping freedom is lost in keeping up a stiff mileage schedule. Auto-camping should be vagabondage.

Really, the most satisfactory kind of a trip is to start out aimlessly and wander about from day to day, without a set itinerary and certainly without the necessity of covering a set number of miles. In most sections of the country 75 or 100 miles will bring a complete change of scenery. A small daily mileage permits stops along the roadside to fish or swim, or take advantage of any other pleasant recreation the country offers. Never forget that the primary object of a vacation is to absorb all the good health that Mother Nature offers so abundantly.

CHOOSING A CAMP SITE

IT IS not the easiest thing in the world to pick a camp site. It is unwise to pitch camp in the first field along the road. One field will be passed because of the necessity of trampling some farmer's crop, another because of lack of water, a third because of an abundance of mosquitoes, a fourth because the ground is damp, and so on.

Water for drinking purposes, as well as for washing dishes is essential. So one of the first considerations is a clean water

Points to Remember on the Trip

BEFORE starting on the auto-camping trip, inspect the car carefully. Be sure it is in perfect repair.

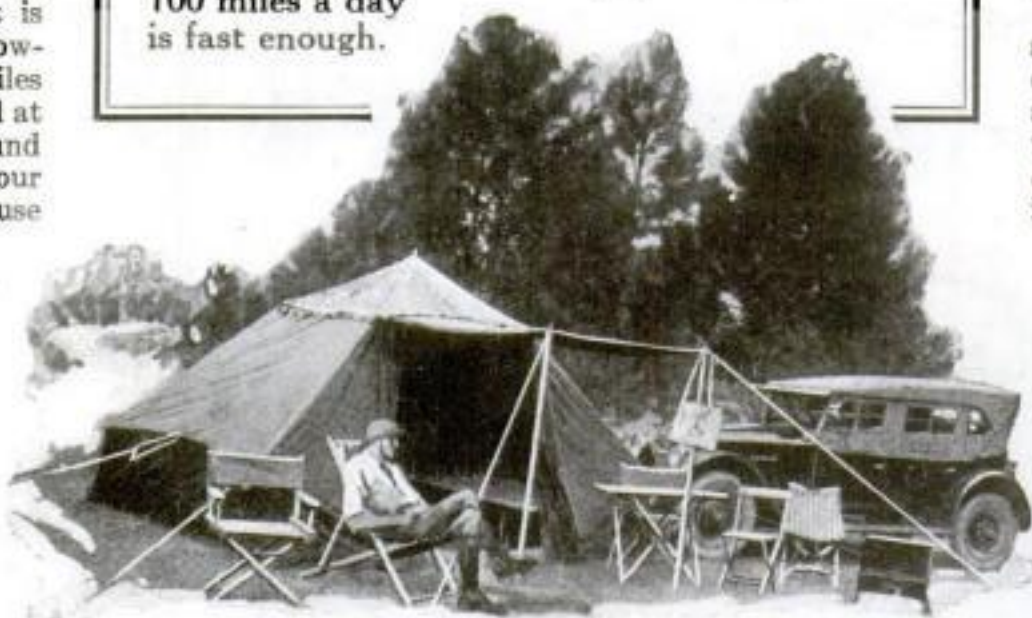
Prepare for any emergency. Carry a collapsible water bucket, tire chains, a pocket flash-lamp, an extra gallon or so of oil, and five gallons of extra gasoline.

Select camping equipment that will pack into the smallest space, yet will provide every convenience.

On the road, as at home, take systematic care of the car. Inspect gasoline tank, oil reservoir, and radiator regularly to see that they are full. Inspect the tires for inflation and needed repairs. Turn grease cups and oil chassis. Change engine oil at least every 1000 miles, preferably every 500 miles.

Drive slowly on narrow or poor roads. Always keep the car under control. Be alert. Obey the laws of the road.

Take your time. To enjoy the trip, 75 or 100 miles a day is fast enough.



A typical scientific auto camp, 1923 style

supply — a brook, spring, lake, or well. The true auto-camper prefers a site as far away from human surroundings as possible. A slightly wooded knoll with water somewhere near usually makes an ideal spot.

GET A TOURIST CAMP DIRECTORY

NEARLY all the 2000 camp sites available this summer are listed in camp directories issued by touring information bureaus. Such books contain maps of the United States showing the principal roads and all the camp sites. In addition, the camp sites are described briefly, as for example: "Wausau (Wisconsin), population 20,000. Shelter. Fireplaces. Stoves. Running water. Toilets. Electric lights.

Wooded. One mile out. Police protection. Free. No permit required. Information at Chamber of Commerce."

As a rule, these camp sites are equipped with stone fireplaces for cooking, although some have stoves burning wood or coal, and others gas stoves. They are supplied with water and electric light, toilets, rest rooms, laundry facilities, and shower baths. Often fishing and bathing are listed as attractions.

THE CAMPING EQUIPMENT

IT IS not necessary to load the car nor to clutter up its appearance if the selection of the equipment is done scientifically. Perhaps the most important question is, Where to Sleep? One of the newest types of auto-camping beds may be installed right in the car over the seats. It collapses to golf-bag size, weighs only 13 pounds, and can be installed in four minutes. Then there are several types of tents that are largely supported by the car, being placed at one side like a lean-to on a house. For some of these tents the top of the car takes the place of a ridge pole supporting the canvas. The car forms a firm anchorage for the tent and the space in the car may be used as a "front porch" or a dressing room, as you prefer. Other tents of this character are provided with an awning, which gives the effect of a porch in front. This porch is a convenient place for cooking on rainy days and for loafing when the sun is bright. All these tents are designed to fold into a small space and to be erected quickly.

Tents designed to be erected separately from the car may be obtained in a variety of styles and sizes. Most of the modern tents are insect proof. They have canvas floors, screened openings, including windows and doorway.

ADDITIONAL ITEMS

OTHER ingenious camping equipment this year includes numerous types of folding beds and cots; folding camp chairs, folding tables; runningboard trunks that serve as combination tables and cupboards when the tent is up; folding stoves for wood, kerosene, or gasoline; a wide selection of dishes, pots and pans, and

other cooking accessories that can be packed into a small space. Some of the most useful of the new accessories are pictured on the opposite page.

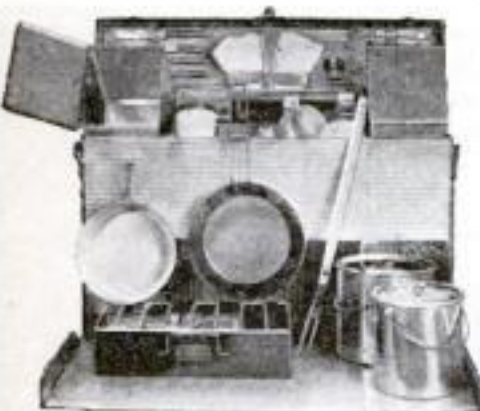
Two-wheeled pneumatically tired trailers are convenient for carrying the usual camping equipment. In fact, some of them actually are folding bungalows. In one typical example the bungalow is built on a platform about seven by five feet in dimensions. When folded, the structure has sloping sides like the peaked roof of a house; but when opened, the sides rise to a perpendicular position. The platform is flanked on each side by a double bed with springs and a mattress. The space between the beds serves as dressing and living room. At the front is a compact, two-burner

(Turn to page 87)

New Aids to Auto Camping Comfort

Tent, Beds, Kitchen, and Tables Can Be Packed into Small Space

Luscious Meals Cooked on the Road by Engine Exhaust Gases



One of the most convenient of all the new auto camping accessories this season is the complete, compact cooking and table outfit shown above. Pots and pans, cooking utensils and tableware, are packed in a small case carried on the runningboard



An iron stake with sharp blade driven into the ground in the center of a fire, serves as a steady support for cooking grids and a coffee-pot hook

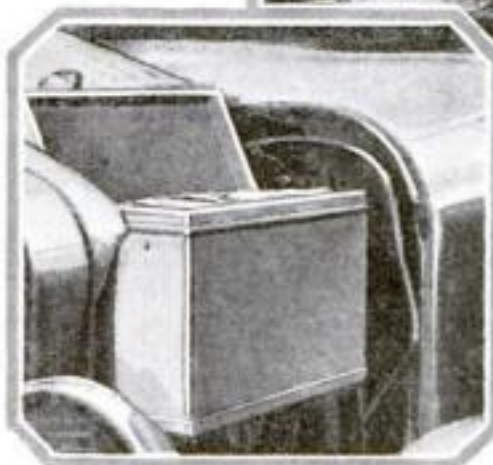


A folding table and four folding chairs, which open like umbrellas, can be packed into a case not much larger than a tennis-racket carrier. The table top folds up to form the case. All legs of the furniture are made of steel

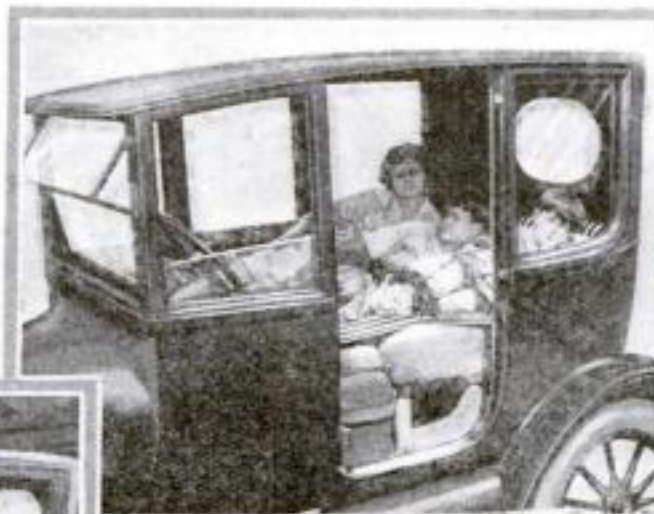


Each of these two types of auto-cookers, when placed under the hood and on the engine, as shown at the left, are operated by the heat from the engine exhaust gases which circulate about the containers within the cooker itself

This folding table collapses to form a runningboard box in which provisions and utensils can be carried, as shown at right. The top of the box forms a shelf. The table is made up of the bottom and two sides



By arranging the seat cushions and spreading a canvas sheet over all, as shown below, the Ford sedan can be transformed quickly into a Pullman sleeper



Plenty of room for the family in the Ford sedan sleeper. The rear cushion is moved forward and supported on braces. The head rests upon a canvas cushion fastened across the rear



The tent, a table, a bed for two and benches for six fold up into a compact runningboard box (below) that weighs only 150 pounds



This tent, with screened windows on all sides, is supported by a folding steel framework that is easy to erect and stretches the canvas so that it is windproof and watertight



Equipping the Auto-Camping Car

WHAT is the best way to equip your car for auto camping without building a special body or going to any unnecessary expense?

This is a question that confronts thousands of prospective auto campers this summer. I shall, therefore, give in brief outline what equipment is considered essential for a party of four on more or less extended camping trips, and a convenient method of disposing of it about a touring car to the best advantage.

Camping with four in the party is desirable because the services of each person can be utilized for special duties and in that way the work divided up and disposed of in the least time. One person takes care of the car and the mechanical details of greasing, oiling, and adjusting it. Another does the cooking and has charge of the food supplies and cooking utensils. The third person cares for the tent and sees to its erection, dismantling, and stowage, and the fourth arranges for water and firewood, chops sufficient wood to maintain the campfire, and gathers pine boughs for bedding, if used.

These duties must be attended to properly, if camping is to be done in comfort. It is also important that the equipment should be carefully chosen to avoid overburdening the car and yet to forestall breakdowns and other difficulties through lack of the proper supplies.

The equipment in the following list has been carefully selected, and furnishes a good basis for preparing an individual camping list.

By George Arthur Luers

Automotive and Mechanical Engineer

Fit the 5-gal. can to the right running-board and place the grate under the rear floor mat. Mount the tires on the left runningboard. Put the rolled-up beds on end in back of the front seat and stow the cooking utensils between the beds.

The rolled-up tent is carried on the left runningboard; the shovel is strapped to

a bumper, rests are placed between the horizontal supports, and extra body braces are added to make a shelf heavy enough to support the trunk. Strips of structural steel, about 3/16 by 1 in., will be found useful for this.

The trunk is a wooden box with hinged top, lock, and cover—made of waterproof leather substitute or rubberized fabric. While dimensions are shown on the detail drawing, they may be modified to suit the available space of your particular car.

The tires are held at the side of the car by strap stays, with a bracket above, as shown, to support them rigidly. The water-can carrier is a wooden block with a recess to take the bottom of the can. Stays are attached to the runningboard so that the can may be strapped in place in the manner illustrated.

Too much attention cannot be given to providing solid stays and stout leather straps to hold everything solidly, for a shifting load adds considerably to the difficulty of driving. It is desirable to provide stays and a strap even for the gallon oil can under the engine hood.

The camp grate, which is simply a wire or sheet metal grid with removable legs, can be made or bought.

This equipment represents the bare essentials and various additions and refinements can be made to suit individual requirements.

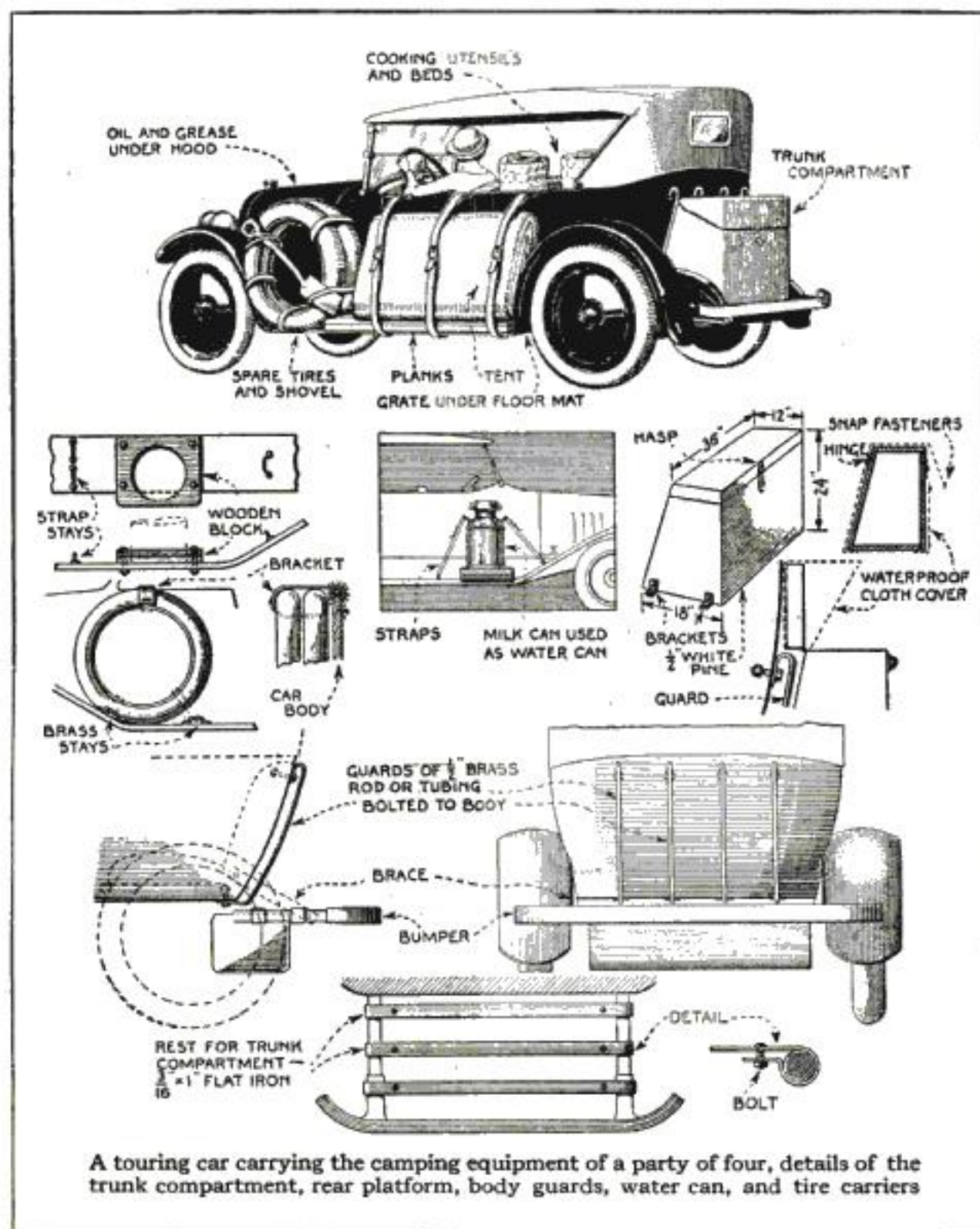
Preparedness is about half the battle in camping; and a definite plan for carrying the equipment, as well as a thorough knowledge of the route and camping sites, will

eliminate the hardships that unprepared campers sometimes meet.

A Few Extra Hints

Even with the equipment stowed as described, it is advisable to prepare to camp early in the evening before darkness has come, because ample time is needed to get the camp in order. It is well, also, to obtain permission from the owner of a campsite, in order to avoid being disturbed after the tent is up.

For long camping trips and where more elaborate equipment is to be carried, it is desirable to build a special body for the car. How to do this most economically was told in detail in POPULAR SCIENCE MONTHLY for June, 1922, pages 77 and 78.—THE EDITOR.



A touring car carrying the camping equipment of a party of four, details of the trunk compartment, rear platform, body guards, water can, and tire carriers

Car Equipment

1 shovel	30 ft. 1/2-in. manila rope
1 gal. oil	1 lb. cup grease
5 ft. high tension wire	20 ft. smaller wire
Folding canvas bucket	Extra lamp bulbs
Extra hose connection and clamp	
Package of waste or paper towels	
50 ft. 1/4-in. sash cord for lashing	
2 extra tires, 2 tubes, 2 blowout patches	
Set of tire chains and extra cross links	
2 pieces of wood 1 1/2 in. by 10 in. by 4 ft.	
Regular tool equipment for the car, including jack, pump and tire tools.	

Cooking Equipment

Grate 10 by 24 in.	4 tin or aluminum cups
2 baking pans, 10 by 14 in.	4 tin or aluminum plates
Frying pan	Knives, forks and spoons
Coffee pot	Breadpan
Cooking pot, 10 in.	Pot hooks
Food bag or fiber food kit	

Tent and Camping Equipment

Tent, 9 by 9 by 7 ft., with canvas floor	
2 4-ft. padded canvas mattresses or 4 cots	
Camp light or spotlight with wide reflector	
4 ponchos	5-gal. water can

the tires; the cans of oil and grease are carried under the engine hood. Food, clothing, and miscellaneous supplies are packed in a trunk compartment at the rear of the car.

The equipment necessary for accomplishing this can be made quite easily and inexpensively by the car owner himself. The trunk compartment is the most important item. To make room for it, the tire rack is dismantled and either permanent or temporary guard rails are placed on the back of the car. These rails are brass rods, tubing or wrought iron bars 1/2 in. in diameter, fastened with bolts through the body and the frame of the car. A space of 2 in. between the body and the guards keeps the trunk from rubbing the paint and provides means for lashing on extra bags.

Assuming that the car is equipped with

Concrete Fountain Is Cheaply Built

By Roland M. Knight

TO BUILD an attractive garden fountain, and benches, pillars, and curbing of concrete is not particularly difficult and costs surprisingly little or materials.

Those illustrated were made in spare time by the writer and a companion in a few weeks at a total outlay of \$17.50, mostly for cement. Gravel was obtained on the property, a California ranch, and old lumber used for the forms.

The fountain is fed from an elevated water tank and the pool is stocked with goldfish and water plants. Almost every morning birds can be seen splashing in their bath just above the pool.

To avoid the cost of a wooden form set in the ground, the ground itself is used as a form. That is, a round, smooth trench 6 in. wide and, in this case, 6 ft. 9 in. in diameter, and 2 ft. deep, is dug and filled with concrete so as to leave the top of the wall perfectly level with the ground. The mixture we used was simply one part of cement to six parts of gravel, although the customary mixture for watertight concrete is one part cement, two parts sand, and three parts aggregate.

After the wall hardens for three or four days, dig out the earth inside the circle, clean the concrete, wet it well, and plaster with a mixture of three parts fine sand to one part cement, smoothing it with a wet brush.

The form for the bird bath is made by fastening together 1-in. boards with cleats and sawing out a disk 28 in. in diameter. In the exact center a 6-in. hole is sawed. A strip of smooth, heavy tin 4 in. wide is tacked around the edge of the disk so that it extends 3 in. above the upper surface of the boards.

Next, dig a hole in the ground in the center of the pool 6 in. in diameter and about 12 in. deep. Set in it two or three lengths of 6-in. stovepipe, according to the height desired, and put several pieces of old iron rods or pipe for reinforcing. Fit the bird bath form on top of the stovepipe and brace

the whole from the ground firm and level.

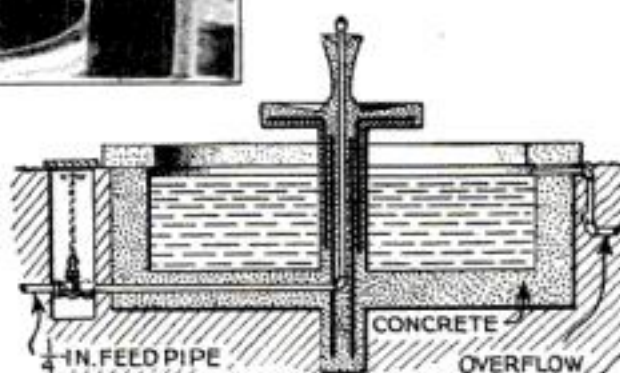
To reinforce the bird bath, bend about half a dozen strong iron rods at right angles and let one end of each piece extend down into the stovepipe and the other end point out into the form. Then lay a piece of heavy wire around the form near the edge for additional strength.

Put in a $\frac{1}{4}$ -in. water pipe for feeding the fountain and let it extend about 12 in. above the bird bath. Pour moist concrete made with gravel into the stovepipe,



and fill the bird bath form with concrete made of fine sand and cement. Then whittle the edge of a small board of hard wood to the shape of the depression to be made in the top of the bird bath and, the day after pouring the concrete, fasten one end of the stick to the $\frac{1}{4}$ -in. pipe in the center and scrape around and around until the hollow is about 1 in. deep.

Fill the bottom of the pool with coarse concrete 5 or 6 in. deep and pour on a top layer 1 in. thick made of one part cement and two parts fine sand. After three or four days, remove the forms from the bird bath and pedestal, the stovepipe being taken off by unfastening the seam with pincers. It is advisable to put a concrete collar around the bottom of the pedestal to assure rigidity.



Stocked with goldfish, this fountain is the center of interest in a lovely California garden. The sectional diagram explains the construction

The rim of the fountain is made in eight sections cemented together when placed in position. The one illustrated is 9 in. wide, 4 in. high, and 7 ft. in outside diameter. Put in an overflow pipe before placing the rim.

The form for the one-eighth section was made at a woodworking mill and cost but a few dollars. Any shop with a bandsaw can make this form if furnished with a pattern.

The easiest way to make a pattern is to draw a right angle on the floor and drive a nail through the end of a long slat into the corner of the angle. With a pencil fastened at the other end of the slat make a quarter circle of the correct radius and cut it in two to give the exact pattern for the one-eighth section.

The ornament on the bird bath was made by first casting a cylindrical piece of concrete around the water pipe and the next day, while it was still quite soft, scraping it around and down to the desired shape.

By the time the fountain is finished, these seats will give little difficulty. Simply build wooden forms and fill in with concrete. Any irregularity caused by the use of old lumber can be removed by scraping before the concrete is very hard, or

using a cement plaster.

Do not let concrete harden too rapidly or it will crack. Take great care in removing the forms, since half hardened concrete is easily broken. If it is in the hot sun, cover the concrete forms with burlap sacks and keep them dampened for a few days.

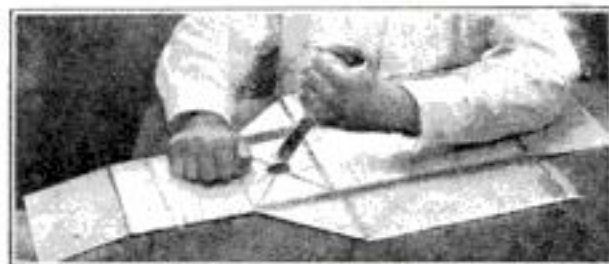
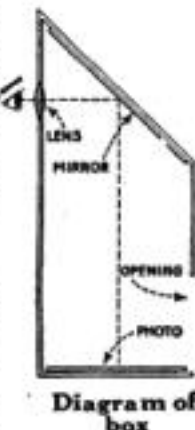
Water lilies and other water plants may be grown in the pool. A narrow flower bed just opposite the rim of the fountain adds to the ornamental effect.

Photos Given Realistic Depth by Toy "Stereoscope"

By Dr. Ernest Bade

DO YOU know that looking at a photograph with only one eye gives the effect of depth and distance similar to a stereoscope? Try it by closing the right eye and making a narrow tube, holding it to the left eye, and looking through at a photo placed about 2 in. away. Keep the other eye closed and take care that only the picture and none of the surroundings are seen, or otherwise the effect is spoiled.

This stereoscopic effect, which, of course, is only apparent, can be explained by the fact that the ordinary camera has only one eye, one lens, and the picture seen is a true picture of what is observed, so that when the resulting picture is seen with only one eye, the photo appears to stand out realistically. This principle makes it possible to construct very simply and easily a stereoscope



In making a box for the toy "stereoscope," the parts are cut out as shown and glued together with tape at the corners

for the children. All that is necessary is a cardboard box about 1 ft. long, a cardboard frame, a double convex lens, and a mirror.

The box is made as shown, and a $\frac{3}{4}$ -in. peephole is cut in the front near the top. The near side of the box has a large opening close to the bottom; this should take in about one third of the entire length. The top slopes downward toward the back at an angle of 45 degrees.

A mirror is fastened firmly to the top of the box in such a way that the image of a photo placed at the bottom of the box can be seen through the peephole. When the

mirror is in place, glue the box together and cover with ornamental paper.

The lens should have a focus of at least 10 or 12 in. Often a double convex spectacle lens that has been discarded can be found in the junk box, and this will serve if nothing better is at hand. Fasten the lens to the peephole.

When the box is ready, place a photograph, a postcard made from a photograph, or a magazine photograph in the bottom and look at it through the lens. The effect will be the same as if a stereoscope was used with two lenses



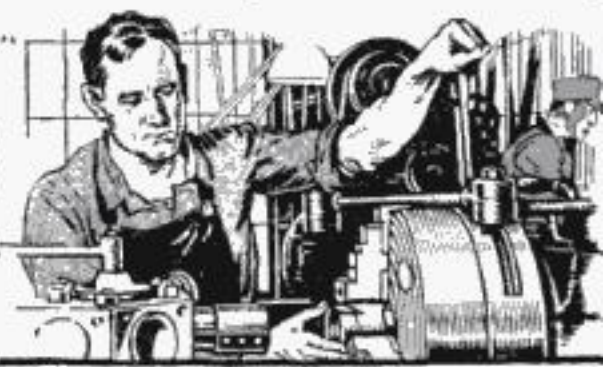
The photo is placed in the bottom of the box

and a double photograph.

If a reproduction of a painting or wash drawing is used instead of a photograph, the result will not be the same, because an artist draws and paints objects as he sees them with both eyes open.

Better Shop Methods

How Expert Mechanics Save Time and Labor



Drilling Accurately by Short Cut Method

By John Aures

THE use of locating buttons is undoubtedly the best method for locating and boring holes when the holes must be accurately placed, yet it has the disadvantage of being the most expensive. It always means the expenditure of much time and labor. A great many small jigs are, of course, made for drilling clearance holes in work, especially when a limit of .005 in. in the location of the holes is sufficiently close. But the average mechanic necessarily has recourse to his height gage and buttons, although he may have a working limit of several thousandths.

As I had much work of this nature to do, I originated a method of laying out and drilling holes in small work to within a limit of but a few thousandths, using only simple tools.

The tools used are but simple ones—a surface gage, magnifying glass, dividers, scriber, scale, center punch, and a light hammer.

Good Magnifier Essential

My magnifying glass has a hole drilled in the end of the handle so as to fit tightly on the scriber on my surface gage (Fig. 1). The dividers, which are of the round-leg variety, are ground to a fine, true point. Occasionally I use a pair of draftsman's dividers, using needles for the points. The center punch is ground on a universal grinder to a 60-degree point. It is very important that the dividers and center punch be kept perfectly sharp.

For lines that must be scribed close to the edge of a scale or straight edge, I use the scriber shown in Fig. 2. This is made of a piece of $\frac{1}{8}$ by $\frac{1}{4}$ in. tool steel about 4 in. long, one side of which is ground flat on a surface grinder and the other side beveled off to about a 20-degree angle. The sharp edge has a slight radius. For most scribing, however, I use a metal pencil holder of a standard refillable type, in connection with needles of a suitable size. This makes an ideal scratch awl, as the points are quickly replaced when dull.

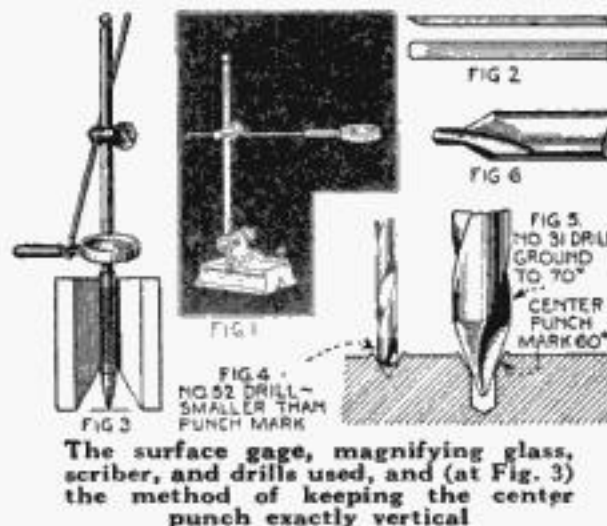
In addition to the scale in general use, which reads from sixty-fourths up, I find one graduated in hundredths and fiftieths to be indispensable. The lines on some of the scales are about .005 in. wide. This, however, is not always the case and is not so on scales graduated in hundredths. But the width of the lines, which must be known, can easily be found out.

The way I accomplished it was to collect a number of hairs, both human and animal, and, laying them beside some of the lines on my scale, I compared them under a strong magnifying glass. A difference of a thousandth or two between the hair and the line can be seen plainly. Having found a hair that compared in width with the lines, it was necessary only to "mike" it to get the width of the lines.

Knowing the width of the lines, it is com-

paratively easy for you to set your dividers to within the limit of a thousandth or two by comparing the point of the dividers with the width of the line. This must, of course, be done under a magnifying glass.

My way of holding the glass by means of a surface gage will be found useful, as it permits the freedom of both hands.



Start laying out the holes in your work with the one nearest the center and then, if possible, lay out the rest of the holes from this point. As you scribe off your lines you can feel with the point of your dividers where the lines cross and, with a little patience, scribe from there without shifting from the lines.

After all your holes have been laid out, give each one of them a slight center-punch mark. When making the marks it is very important that the center punch be held perfectly vertical. In order to do this, I fold the spindle across the back of my surface gage and stand it on end, using the V-shaped groove at the bottom of the gage for holding the center punch straight (Fig. 3). Feel where the lines cross with the point of

your center punch and, holding the punch place, bring the surface gage against it. If your work is too small or of such a nature that the gage cannot be placed on it, straddle a small pair of parallels across the work and place the gage on them.

After giving the locating points a slight punch mark, examine them closely with your glass. You will very likely find your mark in the very center of your line. If

but a thousandth or two, the divergence can plainly be seen with your glass. Go over your punch marks about three times, examining them each time with your glass. If a heavy punch mark were to be made at the outset, it would be infinitely more difficult to correct than a slight one, if any correction should be needed.

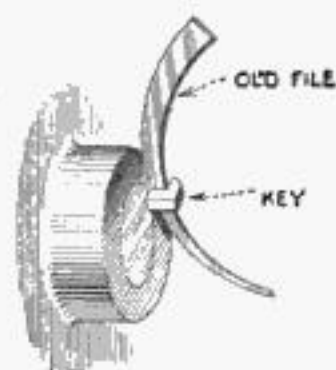
Having laid out all your holes correctly, you are ready to drill them. As your careful laying out will be of little avail if the following directions for drilling are not adhered to closely.

Start drilling your holes with a drill smaller than the outside diameter of your center-punch mark. The punch mark preferably should be made to receive about a No. 52 drill. The reason for this is that the punch-mark has a slight burr around the edge and the lips of the first drill used were to come in contact with the burr, the drill would be almost certain to deviate from its proper course.

Drill to a depth of $\frac{1}{8}$ in. (Fig. 4). Next take a No. 31 drill and grind the lips to an angle of 70 degrees. Your punch marks are, of course, 60 degrees. This drill, therefore, will cut into the sides of the hole already drilled before coming into contact with the center punch burr (Fig. 5).

Now take a center drill, the drill part of which should be $\frac{1}{8}$ in. in diameter. This will just fit the hole snugly and act as a pilot for the countersink part (Fig. 6). Countersink the holes with this until slightly larger than the drill and reamer that will be used for the finished holes. Check up your holes and you will be surprised at having attained an accuracy you never thought possible with such simple tools.

A Crescent-Shaped Key Puller



A GOOD puller for gib-head machine keys can be made from an old 12-in. file forged to shape as shown. The edge should be ground smooth.

The tool is driven under the head of the key in the same way as a wedge, but it is superior to the wedge or chisel commonly used.—J. U.

Indexed Box Keeps Drills Sorted

By Henry S. Laraby

Tool and Die Maker

MACHINIST and home mechanic alike will find this novel holder for small drills a time saver in locating the right drill. By turning the top so that the desired number in the dial comes opposite the arrow mark on the case, and by shifting the knob to one of four possible positions, an outlet hole is automatically brought opposite the compartment in which the required drill is to be found. A careful study of the details in Fig. 1 will show more clearly how this can be accomplished than can be explained in words.

The parts are comparatively few and yet, when properly indexed, the box will keep the small drills sorted and ready for immediate use. The metal parts are made almost entirely of brass and the body of the box is wood.

Turn a shank on a piece of brass $3\frac{3}{4}$ in. in diameter and 4 in. long. True the outside and face it off (Fig. 2, A). Remove it from the chuck and saw disks Nos. 3 and 4 from $\frac{1}{32}$ -in. sheet brass, making them $\frac{3}{16}$ in. over the size of the finished diameter. Sweat these with solder centrally to the face of the large brass piece. Re-chuck the piece and turn and bore the disks to size. Then use heat to remove them without bending.

Next, turn the outside of collar No. 1 (see B, Fig. 2) and stamp the arrow on

it before boring the inside. Bore the inside to $2\frac{15}{16}$ in. diameter and, after polishing with emery cloth, cut off the collar.

Turn the outside of cover No. 2, as at C, and smooth with emery cloth, but do not bore out. Put the piece in the indexing

seven holes on the circle already scribed. Drill through these spots first with a $\frac{1}{16}$ -in. drill in the vertical head and then follow with the drill called for. Mill out the $\frac{1}{4}$ -in. connecting slot $\frac{1}{4}$ in. wide, as shown in No. 2, Fig. 1.

Bolt disk No. 3, as at I, Fig. 2, in place inside the cover, No. 2, and place the knob, No. 8, in any one of the $\frac{3}{8}$ -in. holes. The $\frac{1}{8}$ -in. hole in disk No. 3 is then spotted with a $\frac{1}{4}$ -in. drill, after which the knob is removed and the $\frac{1}{8}$ -in. hole drilled. The blocking placed in the cover for this operation is removed and the knob No. 8 is bolted in place on disk No. 3, as at L.

With the knob in place on disk No. 3, and the disk in its place in the cover, No. 2, and the short bolt also in place, drill the holes in disk No. 3 through the holes already drilled in cover No. 2. Care should be taken, as shown at J, to drill hole No. 1 when the knob is at a; hole No. 2 when the knob is at b, and hole No. 3 when the knob is at c.

Place the wooden box in the indexing head chuck, and true it up as at K. Put on cover No. 2 and locate for boring the holes in the box. Then remove the cover and bore the 20 holes in each circle with the proper drill. Either extra long drills can be used or the drills can be pieced to get the correct depth.

After drilling, the box is placed on an arbor as before and finished to size, shellacked, and polished. The bottom disk, No. 4, is then screwed on. The assembly of the knob is shown in detail at L, Fig. 2.

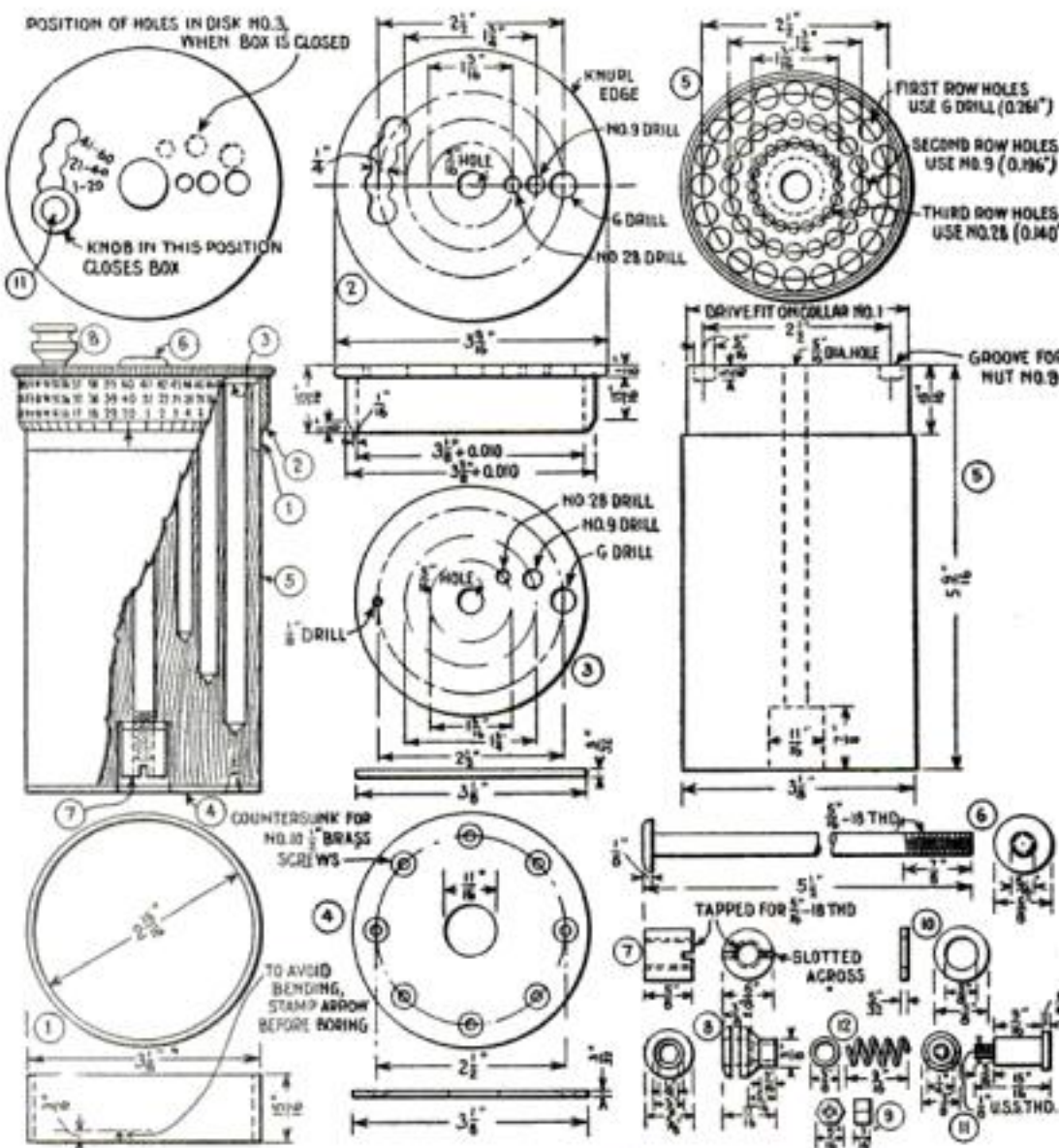


Fig. 1. Working details of the drill box. It not only holds a large number of drills, but automatically selects the one needed.

head chuck and scribe 20 lines, as shown, on the circumference, taking care not to make the lines too deep, and bevel the edge. Remove the piece, mark the lines on the bevel, and stamp the drill sizes.

Re-chuck the piece in the lathe, as at D, true up, and bore out the inside of the cover. Also bore the $\frac{5}{16}$ -in. hole through the center and smooth with emery cloth the metal raised by stamping the outside. Reverse the piece in the chuck, as shown at E, and turn off the shank; also face off the $\frac{1}{16}$ -in. surplus left for finishing the top surface and knurl the edge of the flange. Then lightly scribe three circles on the cover as shown in Fig. 1, and mark a center line across the cover.

Turning the Wooden Body

Rough out a wooden block in the lathe chuck, as shown at F, Fig. 2, and bore a $\frac{5}{16}$ -in. hole through the center. Face off the end and bore a recess for nut No. 7. Put the wooden piece on an arbor, as at G, and if loose, swell the hole with a little water. Turn off the ends to length and turn $\frac{1}{16}$ in. over size at the ring end. Leave the base end over size for chucking and turn a recess for collar, No. 1, so that it will be a tight fit. Also turn a groove for nut No. 9 (see groove in No. 5, Fig. 1).

The next step, as shown at H, is to put cover No. 1 in the indexing head chuck set for 20 divisions and spot for the



A commercial drill box working on the same principle and patented by the Morse Twist Drill and Machine Co., through the courtesy of which firm any reader may make the drill box described above for his personal use

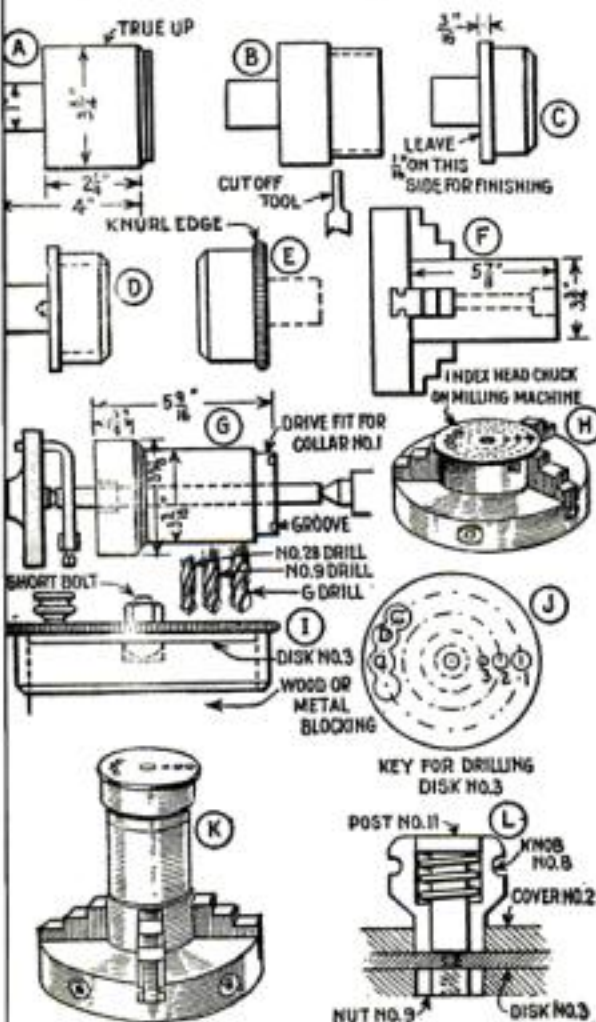


Fig. 2. Operation chart showing the order of steps in machining and assembling the drill box parts

"FROM Machine Shop Apprentice to Production Engineer," and "Building a Jobbing Business" are two remarkable machine shop stories scheduled for early publication in the Better Shop Methods Department. On the schedule are also articles of real dollars and cents value by such experts as Joe V. Romig, Henry S. Laraby, George A. Luers, John Aures, W. Schaphorst, and B. R. Wicks.



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Foot Operated Turntable Saves Time in Welding

TO SIMPLIFY the work of welding caps on cylinders of about 4-in. diameter, an acetylene welder built the simple rotating clamp illustrated. With



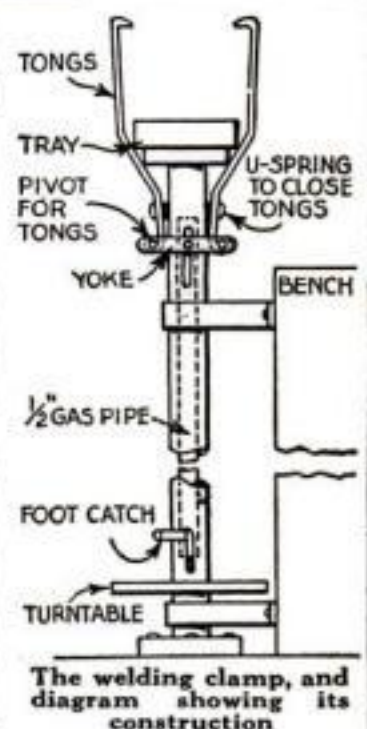
slight modifications the same clamp can be used for other similar jobs.

It consists of a piece of $\frac{3}{4}$ -in. pipe about 30 in. long, with two slots $\frac{3}{8}$ in. wide and 2 in. long cut through about 6 in. from each end. The

lower slot has an L at the top to act as a catch for a clamp rod. A 6-in. iron disk welded on the pipe 3 in. from the lower end serves as a foot-rest and allows the operator to turn the stand with his foot.

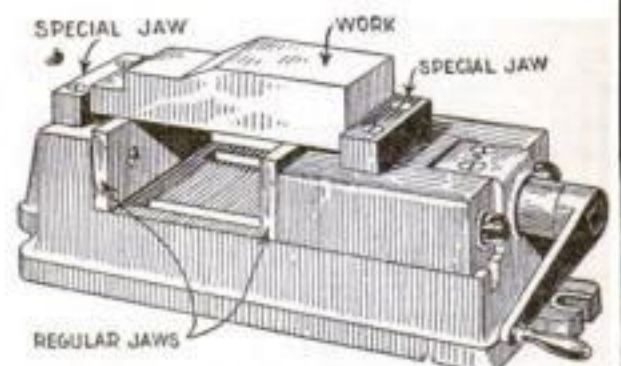
A $\frac{3}{8}$ -in. clamp rod is slipped inside the pipe and drilled to receive the center screw of the yoke for the tongs. The tongs are closed by a U-spring and opened by an upward motion of the rod within the pipe, which wedges them against the $4\frac{1}{2}$ -in. tray. If the pins at the bottom of the rod are slipped into the L catch, the tongs are held open without further effort.

A rope and pulley attachment with a counterbalancing weight support the torch without fatigue to the welder.—EDWIN M. LOVE, Alhambra, Calif.



Extending Capacity of a Vise

FINDING it necessary in an emergency to extend the capacity of a vise, I mounted two extra jaws as shown and let the work rest on the regular jaws. This



permitted work to be held that was from $1\frac{1}{2}$ to 2 in. larger than the original capacity of the vise. The extra blocks should be at least $\frac{3}{8}$ in. thick or, better still, from $\frac{1}{2}$ to $\frac{5}{8}$ in., to make certain that the work will be firmly gripped.

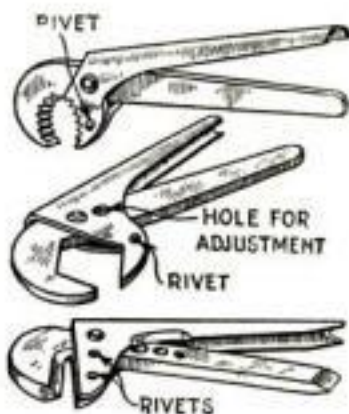
This idea is a useful one for home mechanics, who often find the small range of their vise a drawback.—J. H. MOORE.

BETTER SHOP METHODS

Simple Plier Type Wrenches
Made from Steel Plate

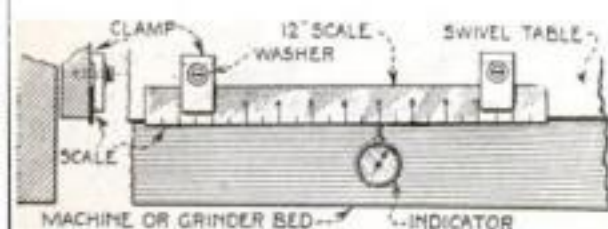
FOR special purposes it is sometimes necessary for a mechanic to improvise a wrench. This is not particularly difficult to do if facilities are at hand for shearing and bending steel plate.

The tools illustrated are made of $\frac{1}{4}$ -in. steel plate sheared to the required shape. One section is then doubled over, riveted, and provided with a pivot pin. The parts must, of course, be properly tempered.—G. A.



Setting Tapers Accurately

SETTING tapers on a grinder, lathe, or milling machine by means of the graduations on the machine itself is usually considered an unsatisfactory method for obtaining accurate results. It makes it necessary to fit and try work when the



A scale clamped to the swivel table makes it possible to cut or grind tapers accurately and quickly

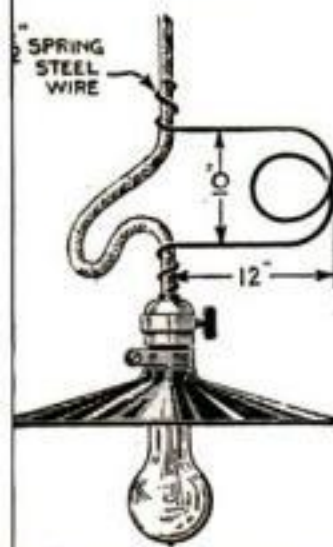
allowance is small. The simple device illustrated, however, makes considerable accuracy possible with much less difficulty.

A piece of work is chucked in the machine and finished off perfectly parallel for its entire length. The scale is then adjusted by means of an indicator so that it is parallel with the work and is clamped in position. After that, the swivel table or carriage is shifted as many thousandths of an inch as is necessary to obtain the required taper. The graduations on the scale allow the depths of large cuts and grinds to be measured accurately.—H. S.

Spring Protects Nitrogen Bulbs

ALTHOUGH nitrogen-filled electric lights of from 100 to 200 watts meet a long-felt need for better lighting in the shop, we found in our shop that the vibration made by cranes and heavy machinery frequently caused the filaments to break, even when the bulbs were suspended on heavily braided lampcords. Because of this, cheaper lights often are still used.

Rather than discard these highly efficient lamps, we made various experiments and finally adopted the shock-absorbing spring shown, which proves satisfactory.—C. J.

10-Day Tube
FreeWhat Men Use
To get those glistening teeth

Note how many men and women show white teeth nowadays.

They are proud to show them when they smile—because they are attractive.

There is a new way of teeth cleaning which millions now employ. It means whiter, safer, cleaner teeth.

Men who want good teeth should use it. Make this free test and see just what it does.

Then dentists everywhere began to advise their use.

A new-type tooth paste was created, based on modern research. The name is Pepsodent. Those two great film combatants were embodied in it, for daily application.

Now careful people of some fifty nations use this new way to clean teeth.

It removes film

You can feel on your teeth a viscous film. It clings to teeth, gets between the teeth and stays. Food stains, etc., discolor it. Then it forms dingy coats. Tartar is based on film.

That's why teeth look cloudy.

Film also holds food substance which ferments and forms acids. It holds the acids in contact with the teeth to cause decay. Germs breed by millions in it, and they cause many troubles.

That's how teeth are ruined.

Fights acid too

Pepsodent also multiplies the alkalinity of the saliva. That is there to neutralize mouth acids, the cause of tooth decay.

Pepsodent multiplies the starch digestant in the saliva. That is there to digest starch deposits on teeth which may otherwise ferment and form acids.

Those are Nature's great tooth-protecting agents in the mouth. Every use of Pepsodent gives them manifold effect.

Avoid Harmful Grit

Pepsodent curdles the film and removes it without harmful scouring. Its polishing agent is far softer than enamel. Never use a film combatant which contains harsh grit.

You must do this

Old ways of brushing do not end that film. Some always remains to threaten serious damage right and day.

So dental science sought a film combatant, and two methods were discovered. One acts to curdle film, one to remove it.

Experts proved those ways effective.

The new-day way

Pepsodent is the tooth paste of today. Millions already use it. All careful people will adopt it when they know its benefits.

Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coats disappear.

Then you will realize what this method means to you, now and in the future. Cut out the coupon now.

Pepsodent
PAT. OFF.
REG. U.S.

The New-Day Dentifrice

A scientific film combatant, which whitens, cleans and protects the teeth without the use of harmful grit. Now advised by leading dentists the world over.

10-Day Tube Free 1095

THE PEPSODENT COMPANY,
Dept. 84, 1104 S. Wabash Ave., Chicago, Ill.
Mail 10-day tube of Pepsodent to

ONLY ONE TUBE TO A FAMILY

BETTER SHOP METHODS

Solving Weighing Problems by Water Displacement Method

By W. F. Schaphorst

NOT infrequently it is desired to know the weight of some part or other on a machine that cannot be detached easily for weighing and is too irregular to be computed quickly. In such a case the weight can be found indirectly by weighing the water displaced by the part, if the part projects in such a way that it can be made to displace water.

The writer, for example, once had to determine the weight of a flywheel governor weight, which was made of cast iron and could not be taken off without removing the whole governor from the engine.

I secured a rectangular sheet metal vessel and weighed it when it contained as much water as could be held in it. Carrying



Displaced water serves as index of weight and cubic contents

it to the engine, I raised it until the water level cut the governor arm.

Next, I removed the vessel and again weighed it, this time with the remaining water. The weight of the governor end was then computed in this manner:

The first weight was 45.5 pounds and the second weight was 39.25 pounds. The weight of the water displaced was, therefore, $45.5 - 39.25 = 6.25$ pounds.

To compute the weight of the cast iron that displaced the water, all that was necessary was to multiply by the specific gravity of cast iron, which is 7.207, or $6.25 \times 7.207 = 45$ pounds.

The remainder of the arm was of regular cross section, the weight of which was very easy to compute on the basis of 0.26 lb. per cu. in., the weight of cast iron.

In case other metal parts are to be weighed in this manner, here are the specific gravities of common metals as I use them, although tables vary somewhat.

Cast iron.....	7.207
Wrought iron.....	7.78
Soft steel.....	7.833
Steel castings.....	7.917
Cast aluminum.....	2.60

Should it be desired to find the volume of the piece of metal in cubic inches, divide the difference in weight (which is equal to the weight of the displaced water) by .0362. The result is the volume of the part in cubic inches.

This latter test will come in handy for finding the volume of any irregular substance that can be submerged in water without harm or without any absorption of water. Or, should one wish to find the specific gravity of coal, brick, rock, etc., reversing this method will serve.—(Copyright, 1923, by W. F. Schaphorst.)



Sargent Steel Pocket Plane

Sargent Auto-Set Bench Plane

Sargent Steel Block Plane

The cutter may be removed and replaced without changing adjustment

THE Sargent Auto-Set Bench Plane will mean a great saving of time and trouble at your work-bench. For whenever you have to remove the cutter, you can replace it at the same adjustment you were using and go on with your work.

The cutter of chromium alloy steel keeps its edge an unusually long time. And always makes shavings—even when cutting across the grain or through tough, knotty wood. The cutter is so

rigid it will never chatter.

For the smaller jobs—the finishing touches or the work in close quarters—use the Sargent Steel Pocket Plane and the Steel Block Plane. They are light, handy, dependable and faithful to your best craftsmanship. See these planes at hardware dealers everywhere.

Write for the Sargent Book of Planes. It is full of detailed information on these fine tools and many other styles of superior planes.

SARGENT & COMPANY

Hardware Manufacturers

50 Water Street, New Haven, Conn.

SARGENT
Tools & Hardware

It's Easy to Build Things with a Junior Bench Saw



Does your ripping, mitring, grooving, rabbeting, tenoning, sanding, grinding and many other operations with surprising ease and accuracy. Top 10" x 13". Saws 1 1/2" stock. Dadoes 3/4" x 1/2". Machine built entirely of metal. Driven by 1/4 or 1/3 h. p. motor. Portable. Attaches to any light socket. Extremely accurate.

Descriptive circular tells many things of interest to workers in wood and soft metals.

W. & J. BOICE, Dept. P. S. 7, Toledo, Ohio

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If so the WORLD PROGRESS will show you how to Protect and Profit From Your Ideas

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is revolutionizing the possibilities of Crystal Sets. Unsolicited testimonials from all parts of the country report records of from 600 to 1200 miles with ordinary sets equipped with

M. P. M. (Million Point Mineral) CRYSTALS

Don't discard your Crystal Set until you have given M. P. M. a trial. Send 25c and name of your Radio Dealer for sample unmounted crystal—35c for mounted. Beware of imitations.

M. P. M. SALES CO., Dept. P. S., 247 S. Central Ave., LOS ANGELES

The Circus—A Mechanical Wonder Show

(Continued from page 23)

appliances. Soon you will see these fans not only in the circus but in theaters, hotels, and other public places.

All the activities I have described in putting up a show take place almost simultaneously, so that within three hours after we reach a lot, the show is ready for business.

Back in 1914 we were late in getting to the lot in Dyersburg, Tenn. We had less than 2½ hours to get ready. Jimmy Whalen, our boss canvasman, put the show up in two hours and 10 minutes. I believe that is a record even for Whalen, who has been putting up shows for us for more than 40 years.

Taking down the show requires an equal amount of mechanical ingenuity. Everything is done at once. While the crews with block and fall are letting go the lines, the mechanical stake puller—a lever on wheels—is lifting the stakes. By the time the last person is out of the grandstand, most of the circus is on the way to the trains.

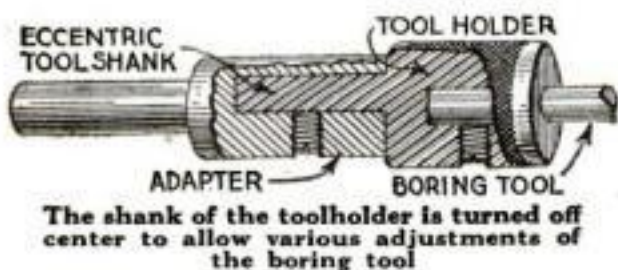
One hundred railroad cars are required to move the modern circus. This railroad equipment is the mechanical outgrowth of the oldtime circus wagon caravan. The boss trainman uses the inclined plane and block and fall to load the circus on the cars. He snakes 14-ton wagons up the incline just as easily as he would a light surrey. A few hours after the show closes, we are on our way to the next town.

And we always get there. We have been in many wrecks, but the mechanical expertness of our train crew always has pulled us out. On one occasion, coming out of Halifax, N. S., we were badly wrecked, but our boss trainman cut the rails on a parallel track, bent them to form a switch into our track, borrowed some equipment from the railroad, and went on his way.

Every one connected with the show knows something about machines. There aren't many industrial corporations that can boast of better mechanics. And that is one reason why the circus is a growing American institution, appealing to the fun-loving public year after year.

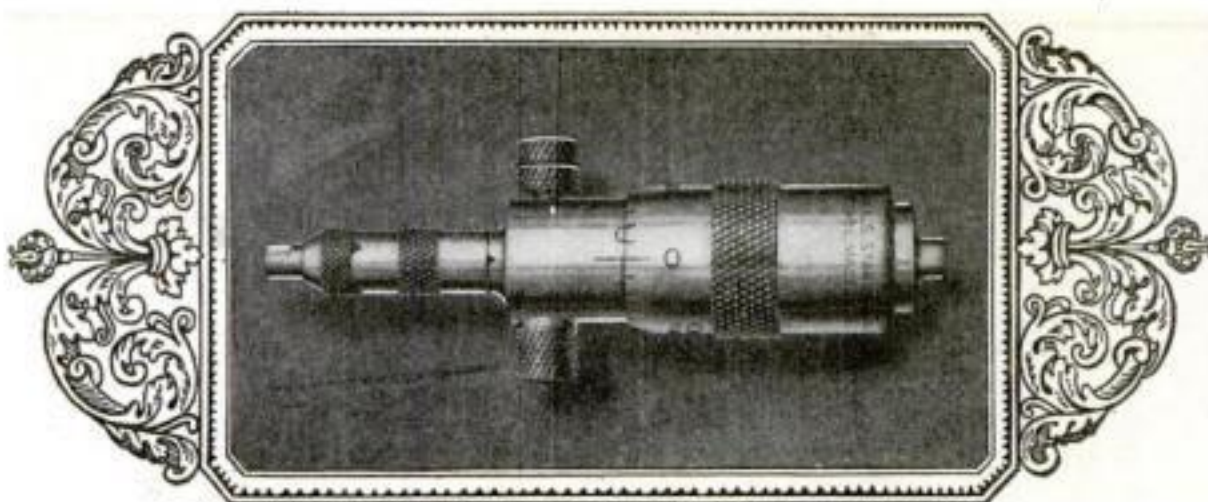
Simple Boring Tool Holder

THIS adjustable boring toolholder is inexpensive and very easily made. The shank of the adapter is held in the milling machine chuck, and the shank of



the toolholder proper is turned off center to allow various adjustments of the boring tool. The size of the toolholder is governed by the work it is to be used upon, but the principle of operation remains the same for all sizes.—L. S.

CAST iron can be bent if heated to redness and gradual pressure (not blows) applied.



No wonder a man is proud of his Starrett Tools

SOME tools *look* well. Other tools are ingeniously designed—they're handy to use. And still others are built unusually well—they're good for a lifetime's use.

Starrett Tools combine *all* these features—convenience, finish and workmanship. And in addition they're the most *accurate* precision tools made. That's why a good machinist says "Starrett" when he's adding to his tool kit.

THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

The Micrometer Head illustrated above is part of our Inside Micrometer Set No. 124. A splendid "mike" which is furnished in four size combinations ranging from Set A (2 to 8 inches) to Set D (2 to 32 inches). Turn to Page 180 of the Starrett Catalog No. 22 "W" for illustration and complete description. Write for free copy if dealer can't supply you.



5351

Use Starrett Tools



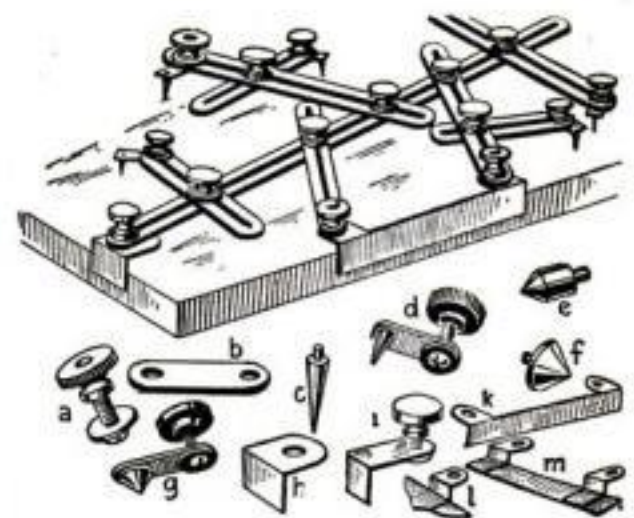
BETTER SHOP METHODS

Transferring Templet Saves Time for Draftsmen and Machinists

By Charles A. Pease

THIS adjustable templet will be found very useful in shop and drafting room for transferring points from one drawing to another, and from a drawing to the work, as well as for prick punching drill holes for duplicate work. The device serves all purposes, for a set of fine, keen points are provided for drafting, and a set of circular 60-degree points for shop uses. If it is to be used for drafting alone, it may be made of wood or of considerably lighter metal than if it is to be used in the shop.

According to the number of arms, it may be used for transferring any reasonable number of points, from one to a dozen or more, all in exact relation to each other and to any other point or place on the work. It may be made of any size desired, from 8 or 10 in. for model and tool work, up to



Made up of interchangeable parts, this templet is used for transferring a layout accurately from one piece of work to another

several feet for large machine work; and within any ordinary range of sizes, all arms are interchangeable. The shorter arms used by themselves form a small instrument.

The size I have found the most satisfactory for my own work is light enough for convenience on the drafting board and yet stiff enough for accuracy up to 24 or 30 in. and, when using the shorter bars, rigid enough for offsetting and prick punching on metal up to 12 or 15 in.

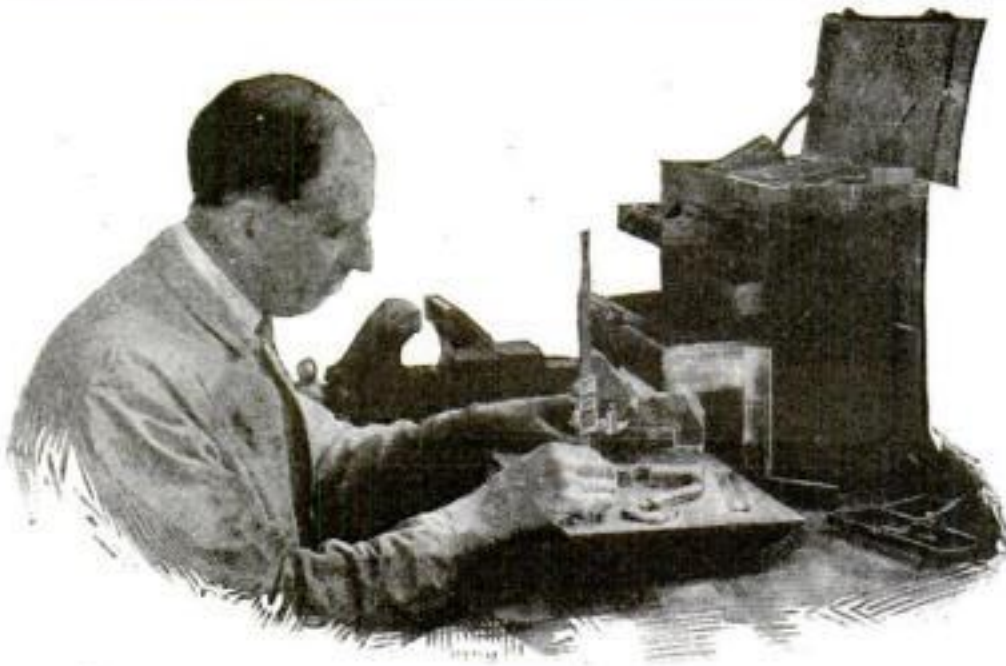
The bars are steel, iron, or spring brass. "Half spring" brass will work the easiest, but is not quite as stiff as spring brass. Saw steel is stiffest, but rather hard to work if you have to cut the slots by hand. Mild steel or brass works easier and is stiff enough for any ordinary work. Brass will make the best looking instruments if you keep it in good shape.

The stock should be in strips 1/16 in. thick, corresponding to No. 14 American wire gage, 18 in. long, and 3/4 in. wide.

For drafting purposes only strips about No. 16 or 1/20 in. could be used to advantage, and if a little extra thickness is desired, the 18-in. bar may be made of No. 12 stock, 1/12 in. If saw steel is used, the material may be two gages thinner.

A good assortment of bars is one 18 in. long, three each 12, 10, 8, 6 and 3 in.; and two 4 1/2 in. This requires eight 18-in. pieces. Cut a slot down the center of each bar a little less than 3/16 in. wide, to within about 1/4 in. of each end, and round the corners and smooth the edges.

Each of the clamping screws for holding



Have You a Precision Tool Kit?

Every Mechanic whose tool kit is complete with Brown & Sharpe Tools, is well prepared to do the close limit jobs that come up every day—he has a *precision* tool kit.

Brown & Sharpe Tools help him do the difficult jobs well—they have helped mechanics do accurate work for over 70 years.

Write for a No. 28 Small Tool Catalog and select the tools that will build up your kit for greater precision.



BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U. S. A.

BROWN & SHARPE TOOLS

Stromberg-Carlson
Radio Head Sets

are preferred by ladies—the adjustment rod telescopes so it will not catch in hair or net.

There are other reasons why Stromberg-Carlson Head Sets are preferred not only by ladies but by all critical users—

The receivers are layer wound and layer insulated—to stand up under high plate voltages.

The ear caps cover the ears—excluding outside noises.

The receivers are balanced as to volume—both ears get the message.

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TELEPHONE MFG. CO.
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Adjustment
Rod
Telescopes

ATKINS
METAL CUTTING
SAWS

FREE Book on Saws

This new book, just off the press, gives all the latest information on saws. Tells how to speed up metal-cutting, get longer and better service from your saws. Gives complete information on selecting the right saw for every job. Shows Atkins metal-cutting saws and machines, and explains their use. Also, contains scores of helpful hints and tables.

This book is based on the experience of practical saw makers and users. It is valuable to every man who uses or buys saws for cutting metal. Send for it NOW.

E. C. ATKINS & CO., Inc.
Dept. D-20 Indianapolis, Ind.
Makers of "Silver-Steel" Saws and Tools

BETTER SHOP METHODS

points is made of a No. 8 round head machine screw with a washer soldered to its head, and a milled thumbnut, as shown at *a*.

For each of the points a piece of thin steel or brass of the shape shown at *b*, about $\frac{3}{8}$ in. wide and $\frac{3}{4}$ in. between the centers of the holes, is required. One hole should be large enough to turn freely on the No. 8 clamp screw, and the other, if for drafting points, should be about $\frac{3}{32}$ in. If for prick punch points for metal, it should be the same size as the other hole, about $\frac{3}{16}$ in. The points should be about $\frac{3}{4}$ in. long, from point to shoulder.

The drafting points may be of soft steel, $\frac{3}{16}$ in. or less in diameter, as shown at *c*, but for prick punching the point should be of tool steel and of the shape shown at *e* or *f*, the angles being from 60 to 90 degrees. The point shown at *e* is for ordinary work, the stock being $\frac{1}{4}$ in. in diameter and the angle 60 degrees, while that at *f* is a "pump center" for transferring centers from large holes, and may be from $\frac{3}{4}$ to $1\frac{1}{4}$ in. in diameter. The points are riveted to the straps, as shown at *d* and *g*. For the pump centers, the piece *b* should be long enough to free the head of the clamp screw.

A single gage for transferring from a drawing to metal is shown at *h* and *i*. A long gage for similar use, with two clamp screws, is shown at *k*. Flat gages, long and short, for use on the drafting board, are shown at *l* and *m*.

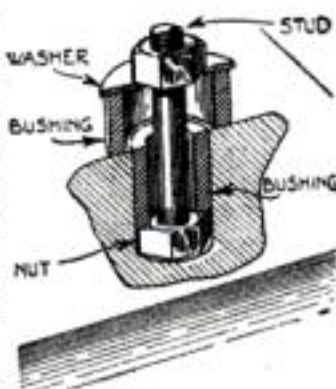
In use the gages are set to bring the main bar in a convenient position relative to the work. The points on the various arms are then adjusted as desired and clamped in place. Two or more points may often be located on the same bar. Where two points or holes are already in a fixed position to which others must bear a certain relation, the first two needles or punch points are set to them and the use of the outside gages is not required. When all the punches are set, the whole device is transferred to the blank, and the gages being brought to the edges, each punch is tapped or pressed to transfer the point accurately to the new work.

The addition of a 24-in. bar, made from stock about $\frac{3}{32}$ in. thick, will increase the capacity of the instrument, especially for heavier and larger work.

Removing Blind Bushings

FOR jigs or machine parts, where it is necessary to use blind bushings that are to be renewed when worn, one way to provide for the easy removal of the bushings is as follows:

The hole for the bushing is drilled deep enough to permit a nut to be placed in it before the bushing is put in. Then, to remove the bushing, a stud is screwed into the nut, another larger bushing is placed over the hole and a washer and nut provide the means of drawing up the bushing.—G.P.



IN FIGURING the capacity in gallons of a tank, change all the dimensions into inches, square the diameter, multiply by the length and then multiply by .0034.



Brass Bound Mahogany Level, No. 1224 Price, \$7.70

To lift your work out of the "amateur" class

THAT'S what this Goodell-Pratt Level is for. Instead of finding yourself a half or a quarter of an inch out of the way when the job is finished, you'll find the job plumbs up true all ways. And that's real satisfaction.

Made of five pieces of thoroughly seasoned mahogany, with brass binding rods dovetailed the entire length and doweled to heavy brass end plates. Side views protected by brass plates.

The vial is accurately ground on the inside and is extremely sensitive. Set solid in the stock, as a double moveable bar adjustment is used. Plumb glass has a similar adjustment.

Size, 24 x 3 x $1\frac{1}{4}$ inches.

Other tools you need

In the Goodell-Pratt line of 1500 Good Tools are many that should be on your work-bench now. Each tool is made with the care and skill that only the best tool-smiths can give to it.

Write for a copy of the Goodell-Pratt Catalog No. 15. It pictures and describes all the tools in which you are interested. The book is free.

GOODELL-PRATT COMPANY

Toolsmiths

Greenfield, Mass., U. S. A.

GOODELL-PRATT

1500 GOOD TOOLS



The Business End of a Bit -

WHEN a bit bores its way thru wood, the important part of the operation is performed by what is called the cutting-head. And this cutting head is made up of several parts, all of which must work together in perfect unison if the boring is to be easy.

The screw (1) pulls the bit into the wood while the spurs (2) cut off the edge of the chips and the cutters (3) scoop them up and pour them into the roomy throat (4) through which they are carried out of the hole by means of the twist of the bit.

It is the perfect working-together of these parts which so distinctively marks the easy boring of IRWIN Bits at which thousands of men have marveled. The reason is found in the design and finish of the business end of Irwin Bits and Augers.

Ask your Dealer to show you an Irwin Bit, then closely examine its cutting head. Get our free booklet, "How to Select, Use and Care for Bits."

THE IRWIN AUGER BIT CO.
Wilmington, Ohio

The IRWIN Bit
Reg. U.S. Pat. Office

You can always tell the genuine Irwin Bit by this Trade Mark on the shank and our Guarantee Tag attached to every bit. These are for your protection. Look for them.



BETTER SHOP METHODS

Plumber's Tool Saves Time in Tightening Washbowl Waste

EVERY plumber knows how awkward it is to hold the waste while tightening it in a bowl or bathtub. Generally the handles of the pliers are used to get a grip, but the simple tool illustrated is much better. It gives a firm hold and does not mar or bend the cross bars in the waste.

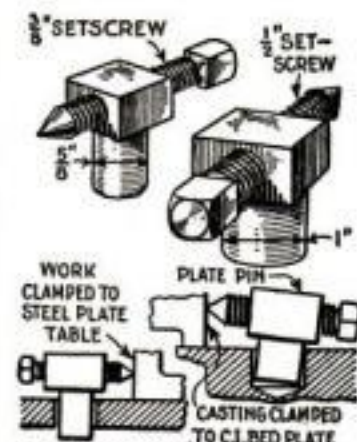
The tool is a piece of $\frac{1}{2}$ -in. pipe about 4 in. long, with four slots at one end. It is threaded at the other for a tee, in which a wooden handle can be inserted, if desired. —WILL W. GIBSON, Maysville, Ky.



General Utility Plate Pins

THE methods used for fastening parts to plates in the shop are important, because much of the work must be clamped down for laying out, drilling, assembling, grinding, boring, and other machine operations. For such fastenings the type of plate pin illustrated is handy because of its adaptability and simplicity.

The body is cylindrical with a square head through which is a tapped hole for a pointed setscrew. The shank is seated in any drilled hole of its approximate diameter in the plate adjacent to the casting or part to be fastened, and the set screw is turned against the work or filler blocks. The canting of the shank in the hole prevents it from being lifted upward. —G. A. LUERS.



Drawing Rounds and Fillets

TO SAVE time in locating centers for radii in making mechanical drawings, I scratched the scales illustrated on one of my transparent triangles. This simplifies considerably the drawing of fillets and rounded edges, which occur so frequently in mechanical drafting.

For instance, if it is necessary to locate the center for a $\frac{1}{2}$ -in. fillet, A, to be drawn so as to connect the lines B and C, the triangle is run along the T-square until the $\frac{1}{2}$ -in. division on one of the horizontal lines rests exactly over the line C, and the T-square and triangle together are raised or lowered until the $\frac{1}{2}$ -in. division on the vertical line rests exactly over the line B, as shown.

A needle point or sharp pencil is then pressed through the small hole to mark the center of the fillet. The point of the bow compass is then placed on the center as marked and the radius swung off directly between the lines. The operation is much quicker to do, of course, than to describe. —R. W. ADAMS, New Britain, Conn.



\$5

"BIASCOPE"
FIX-POWER
Coat pocket size binocular. Weighs only 7 oz. Dimensions $3\frac{1}{2}$ by $3\frac{1}{2}$. Objective lenses are 25mm. diameter, giving 6 linear magnifications. Limp leather case.

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See farther and see better. Wollensak 'Scopes eliminate distance, reveal a myriad of objects invisible to the naked eye, and enhance the pleasure of outdoor life for sportsmen, tourists, hunters, campers, boy scouts, etc.

If your dealer cannot supply you, order direct adding 25c for tax and postage on Biascope and 5c for postage on Pockscope. Moneyback promptly if not pleased.

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quality photo lenses and shutters for 24 years

"POCKSCOPE"

THE POCKET TELESCOPE

Magnifies 4 $\frac{1}{2}$ times. Less than 4 inches long. Weighs only 1 $\frac{1}{2}$ oz. Slips into the vest pocket like a cigar or lead pencil. Complete in limp leather case.



Salesmen \$10 or more per day



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Made \$204.00 last week selling direct to wearer our guaranteed, all-wool, tailored-to-measure suits and overcoats at

\$24.50 and \$27.50

Latest styles; finest fabrics; linings and trimmings High Grade serge or alpaca. Our 25 years experience, perfect equipment, organization, and financial strength enable us to turn out such Superior Garments that sales are easy and repeat orders sure. No experience necessary, we teach you how. Exceptionally Liberal Profits paid you daily at the time each sale is made. We deliver and collect. Complete, attractive outfit absolutely free to salesmen with acceptable references. Territory rapidly being taken up. Make application today for our Fall line—ready early in July.

INTERSTATE TAILORS
403 Pike St. Cincinnati, Ohio

Tires With 500 Nail Holes Leak No Air

Mr. P. J. Milburn of Chicago has invented a new puncture-proof inner tube, which, in actual test, was punctured 500 times without the loss of any air. Increase your mileage from 10,000 to 12,000 miles without removing this wonderful tube from the wheel, and the beauty of it all is that this new puncture-proof tube costs no more than the ordinary tube, and makes riding a real pleasure. You can write Mr. P. J. Milburn at 350 West 47th St., Chicago, as he wants them introduced everywhere. Wonderful opportunity for agents. If interested write him today.

SELL US YOUR SPARE TIME.

You can earn \$15 to \$50 a week writing show cards in your own home.—No canvassing.—A pleasant profitable profession easily and quickly learnt by our new simple graphic block system. Artistic ability not necessary.—We teach you how, and supply you with work.—Distance no object. Full particulars and booklet free.

WILSON METHODS LIMITED—DEPT. C
64 East Richmond, Toronto, Canada.

\$25.00 in Prizes

See page 4 in front of book for full details

Gypsying de Luxe by Auto

(Continued from page 70)

gasoline stove and refrigerator. In addition, the equipment includes lockers, electric lights, screened windows front and rear, and a real screen door at the rear. The weight of the entire outfit is 950 pounds.

A trailer, incidentally, offers few driving difficulties. It follows in the tracks of the car almost perfectly. The advantages of the folding trailer bungalow are that it affords additional comfort, saves time in making and breaking camp, and leaves the car free from the clutter of camping equipment.

Don't Take Chances on Roads

To insure against any possibility of accident that might spoil the entire trip, it is well to guard against taking chances of any kind. When exploring strange roads, beware of mud, especially muddy mountain roads. Wet clay is especially slippery. Sand and loose gravel should be negotiated carefully.

Drive slowly along narrow roads and always keep the car well under control when descending a hill. If a hill is steep enough to demand low gear in ascending it, use low gear in descending it. The same rule holds for second and high gears. In descending long hills, use the engine as a brake, with the gear lever in second or low, to prevent burning of the brake lining. Keep well within the written and unwritten laws of the road; be alert continually, and you will not be likely to meet with a mishap.

Many trips have been spoiled by failure to investigate an unusual noise while the car is in motion. On the other hand, it is a mistake to be too keenly on the alert for strange noises. The clatter of something dropping from the car is worth investigating. By doing this, important parts of the car or accessories, such as spare tires, license tags, and bolts may be recovered.

If it is planned to carry a heavy load of equipment—say 1000 pounds or more—it is advisable, although not absolutely necessary, to add stiffening leaves to the rear springs. You can overload a well built touring car a thousand pounds without breaking the springs, provided you take the bumps carefully. But it is safest to take the car to a spring maker and have extra leaves put in. The cost should not be more than \$15 or \$20.

Carry Only What You Need

A final warning—don't try to take along a lot of extra paraphernalia that you think you "may need." The chances are 10 to one that you never will use it and that it will only kick around in the way. Take just what you are sure you will need for comfort and convenience, and let it go at that.

Be sure to take plenty of warm clothing. Flannel shirts, and khaki breeches are most serviceable for both men and women. Each member of the party should have a sweater and a raincoat. Remember that on the comfort and health of each person depends the enjoyment and success of the entire auto-camping trip.

Next month—Another helpful article by Mr. Blanchard: *How to Clean the Car and Keep It Looking like New.* Practical hints for the automobile owner.

The Receiver of Tomorrow



The Symphony

Tomorrow in Radio means a wider and more useful as well as more entertaining broadcasting. Therefore, to the purchasers of receiving sets, the design, the material, the workmanship, the circuit and the assembly, all play an important part in the quality of reception, and distance heard.

The placing of a Symphony in your home is a permanent investment that will win your instant approval, and occupy a prominent place among your most cherished possessions.

The clear reception and unusual volume are the results of the high grade units, the fine workmanship, the most efficient circuit, and the

correct assembly. The improved circuit used in the Symphony combined with the accuracy of its construction, has increased the selectivity to a marked degree.

The range of the Symphony Receiver is unlimited. Recently, in Chicago, Havana, Cuba, was tuned in not only on a head set but heard plainly on a loud speaker.

The Symphony Receivers are made in two types—Three and Two stages of audio frequency amplification.

If your dealer cannot furnish information on the Symphony, write for illustrated catalog, giving us his name.

JONES RADIO COMPANY

LYTTON BLDG. CHICAGO

The Symphony is manufactured under the U. S. Patent No. 1113149, Armstrong Regenerative Circuit. All parts used in the Symphony are built and inspected by the Kellogg Switchboard & Supply Company, for twenty five years manufacturers of complete telephone equipment.

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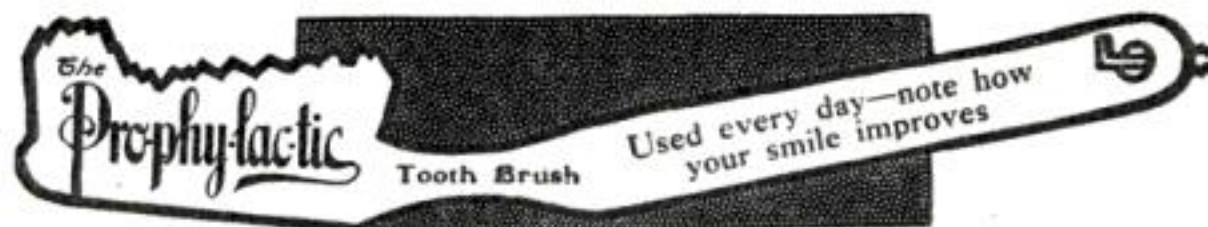
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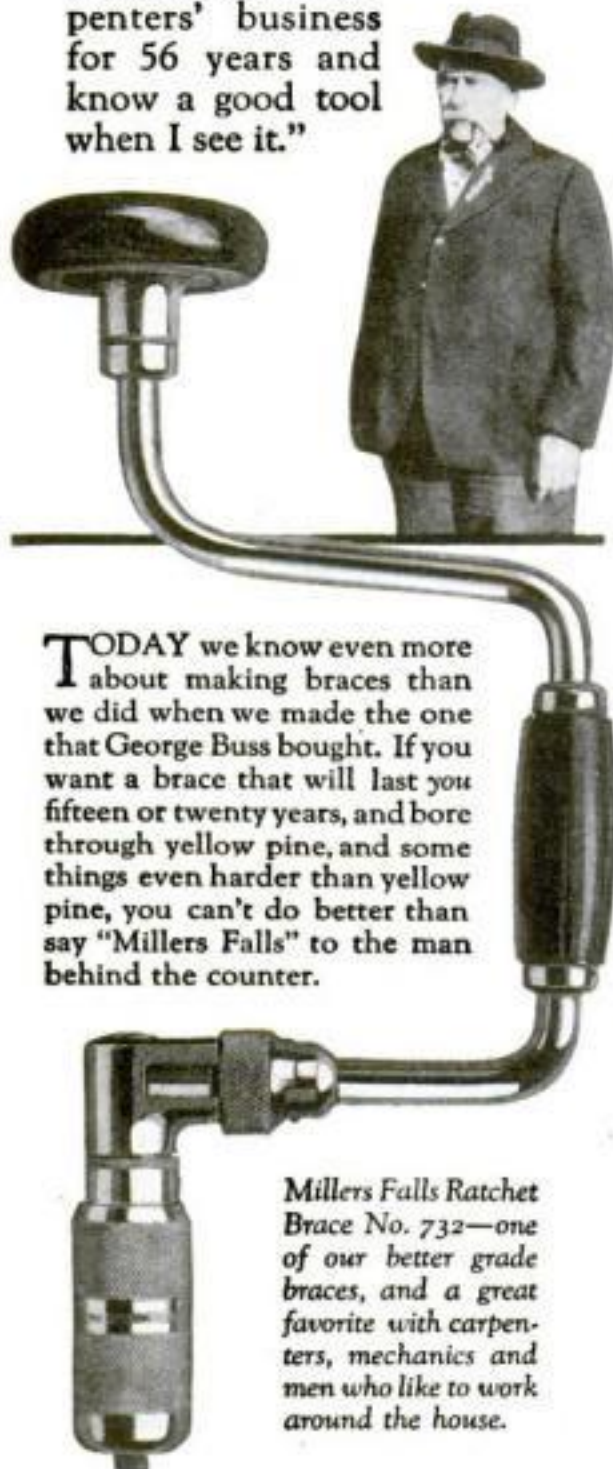


Used every day—note how your smile improves

George Buss, of Elizabeth, N. J., knows a good tool when he sees it!

Here is what he
wrote us recently:

"I HAVE a Millers Falls brace which I have used for 15 years. I have bored through 6" yellow pine with a 1 1/4" bit, and the brace is as good as when I bought it. I have been working at the carpenters' business for 56 years and know a good tool when I see it."



TODAY we know even more about making braces than we did when we made the one that George Buss bought. If you want a brace that will last you fifteen or twenty years, and bore through yellow pine, and some things even harder than yellow pine, you can't do better than say "Millers Falls" to the man behind the counter.

Millers Falls Ratchet Brace No. 732—one of our better grade braces, and a great favorite with carpenters, mechanics and men who like to work around the house.

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TOOLS**

SINCE
1865

THE HOME WORKSHOP

New Motorboats from Old

by Capt. E. Armitage McCann



Third and last of Captain McCann's series of articles on motorboat repairing

OUR old but sound motorboat is now repaired and remodeled at stem and stern and recalked throughout. It now remains only to make good the decks and interior and prepare for installing the engines.

The skin or lining, and certainly the floorboards, should be removed as far as possible. The inside of the hull is then thoroughly cleaned with strong soda, followed by plenty of water. All grease and dirt must be scraped out of the limbers and the limber holes made clear, so that any water taken aboard will run to the lowest point for bailing or pumping.

Should any of the ribs be shaken, broken, or split, new ones should be placed alongside them. Oak is perhaps the best for this, although a more flexible wood is easier to work. They will probably require steaming for an hour in your steam box or boiling for half an hour. If a thin strip of iron is clamped on the outside of them, they can be bent readily to shape on such a board as shown in Fig. 2. The pattern should first be chalked on the board and the rib bent a little more than required for its final shape.

The heart of a motorboat is its engine, so perhaps the next thing to do will be to prepare a bed for it. This must be very firm and so placed and fixed that the strain and stress will be distributed over as much of the boat as possible, the weight being transmitted to the keel. Fig. 3 shows two common types of engine bed, but here one will have to be guided both as to build and position by the kind of motor to be used. Directions for the bed are given, as a rule, with the engine specifications, but it is better to have the engine beside you before laying the bed, even if you remove it again until required.

As a general principle, a piece of tubing or a string passing up the center of the shaft hole from the stern will give the correct position. It must meet the shaft of the engine and be at the same angle.

If the rudder needs replacing or renewing, it may be either of wood or iron. If wood,

it should be of about 1 1/2-in. oak or of a thickness to fit the pintles, and slightly tapered toward the stern. The hardware for it (pintles and gudgeons, Fig. 4) can be bought ready made.

If an iron rudder is required, it had better be bought complete, but can be made by splitting the lower end of a rudder post to take the blade, which is riveted to it. The simplest form of a rudder trunk is a piece of gaspipe large enough to take the rudder post or fill the existing hole. It must be made watertight with wooden stuffing boxes.

The rudder post may extend above the deck or may stop short of it. In the former case, the steering

can be done by a simple tiller, extending forward; but ordinarily a quadrant is used, with wheel ropes extending to the barrel of the wheel. These may be of cord, but light phosphor-bronze ropes are the best.

The neater arrangement is to have the quadrant under the deck, if there is room, but a good plan is to have the quadrant under deck and the rudder post extending above, with a square end and a nut, so that an emergency tiller can be quickly shipped in case the gear breaks down. Figure 5 shows wheel plans. A side wheel takes less room, but is not so convenient for steering as a central wheel.

While this work is going on, the inside of the boat should receive two coats of good paint. The lining and deck planks may now be replaced, making sure that the latter can be lifted easily as occasion requires.

If there is no deck, it is strongly recommended to put one in, even if it is only a small piece in the bow and

stern and a foot or so at the sides, as you have then a much better sea boat and a more comfortable vessel.

Presuming there is already a deck, as is usually the case, but that it is badly scratched, marked, and leaky, the best plan will be to scrape it smooth, fill in the worst hollows with putty and cover it with canvas, laying this down on a heavy coat of wet paint, and tacking it securely with



Rebuilt, shipshape, and ready for the first cruise



Fig. 1. Marking the waterline

If there is no deck, it is strongly recommended to put one in, even if it is only a small piece in the bow and

stern and a foot or so at the sides, as you have then a much better sea boat and a more comfortable vessel.

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THE HOME WORKSHOP

copper tacks. It should go under the covering boards at the sides and the molding round the house in the middle, if any.

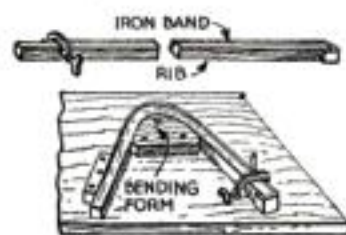


Fig. 2. How to bend ribs

Then it should receive at least two coats of paint. Damping the canvas before the first coat will give a better surface and save much paint. If the deck already is covered with canvas, the paint may be smoothed with paint remover or even burned off and recoated, but if it is patched or torn, it will have to be ripped off. Figure 6 shows how the deck is laid.

It is well to keep some marine glue handy. By its judicious use, many a leaky place can be made watertight without joinery, sometimes by filling a crack with it, and others by gluing a piece of canvas over the part, provided the damaged part is not one affecting the strength of the boat.

Although some boats do not have a cabin, even a small one is very handy, especially when bad weather or rain is encountered. On the other hand, too much open

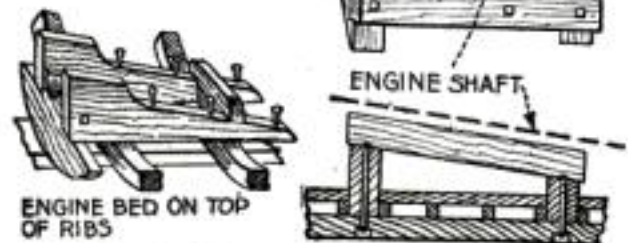


Fig. 3. Two methods of preparing the engine bed

space should not be sacrificed for this, as there is no joy in motorboating in fine weather in any kind of cabin, no matter how roomy or luxurious. It is better to take a chance with the rain.

Suppose there is a little cabin, open at the after end into the cockpit or stern sheets. If it is of solid construction, with portholes or small windows, it is a good plan to cover it with light canvas or duck, and paint it. The top is best treated in this way in any case, but if it is mostly windows, as is usual on the smaller boats, all the old paint or varnish must be removed, the bad places neatly repaired or renewed, and the whole given two coats of good varnish.

A good plan inside is to have a seat or settee along each side, built in, so that there are lockers underneath, with a table down the center, for preference so built that it can be pushed up out of the way. If room can be spared, it is a great convenience to partition off a couple of feet in the fore end for toilet facilities. If there is still room left, a little galley can be arranged alongside this, with some form of oil or gasoline stove so fixed that it will not upset in a seaway.

A small overhang at the after end of the cabin roof helps to keep the rain from blowing into the cabin. Along the top of

(Turn to page 90)

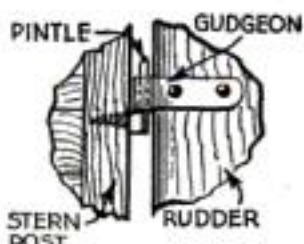


Fig. 4. Rudder detail



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THE HOME WORKSHOP

New Motorboats from Old

(Continued from page 89)

the cabin there should be a grab rail of wood or brass. Cushions, curtains, and the like should be selected, both for appearance and wear.

The arrangement of the cockpit will be governed largely by the position and area of the engine, but the usual plan is to have a seat right around it, with removable cushions. The lining may be either varnish or paint. Arrangements may be made to erect an awning over the cockpit.

The outside of the hull has yet to be painted. It should have three thin coats,

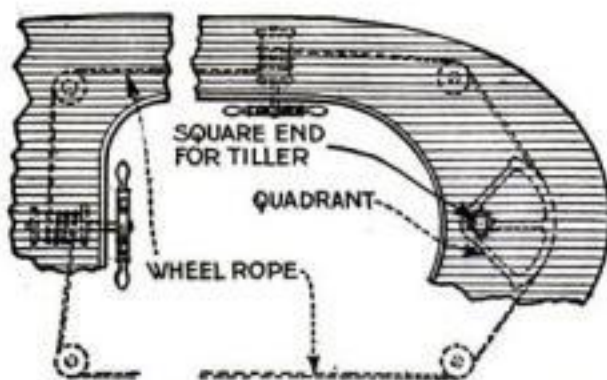


Fig. 5. Diagram of front and side wheel arrangements for steering, the former being the more convenient

applied in dry weather on a clean surface, otherwise you will be troubled with blisters.

The most difficult part of this operation is cutting the waterline. If the boat has been previously painted, before removing the paint, mark the waterline height at the stem and stern. Then if you have a level floor to work on, wedge the boat up so that it is dead upright and the same height from the floor at both ends, the line can then be marked with a stick of the right length, across the top of which a piece of chalk is laid. Unfortunately we cannot usually find this level floor. If one can find a couple of helpers, it may be done with a chalk line, but even with this guide it is no easy matter, as the boat curves in at the ends, and the string will not do this without getting out of level.

An easy method is to get a piece of tubing, to insert a piece of gage glass or other glass tube in each end, fill this with colored or muddy water, fix or have some one hold one tube to one of the marks, and see that the water is up to this level. The water at the other end will always be at the same level and you can mark from it. The actual painting is best done with a long, flexible straight edge and a painter's lining fitch. The underwater portion should be painted with some good copper paint and the upper to please your own taste.

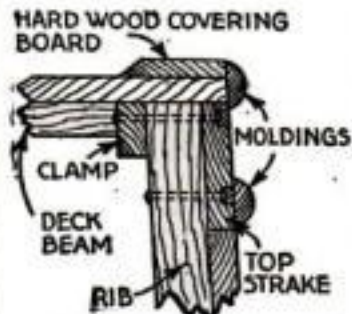
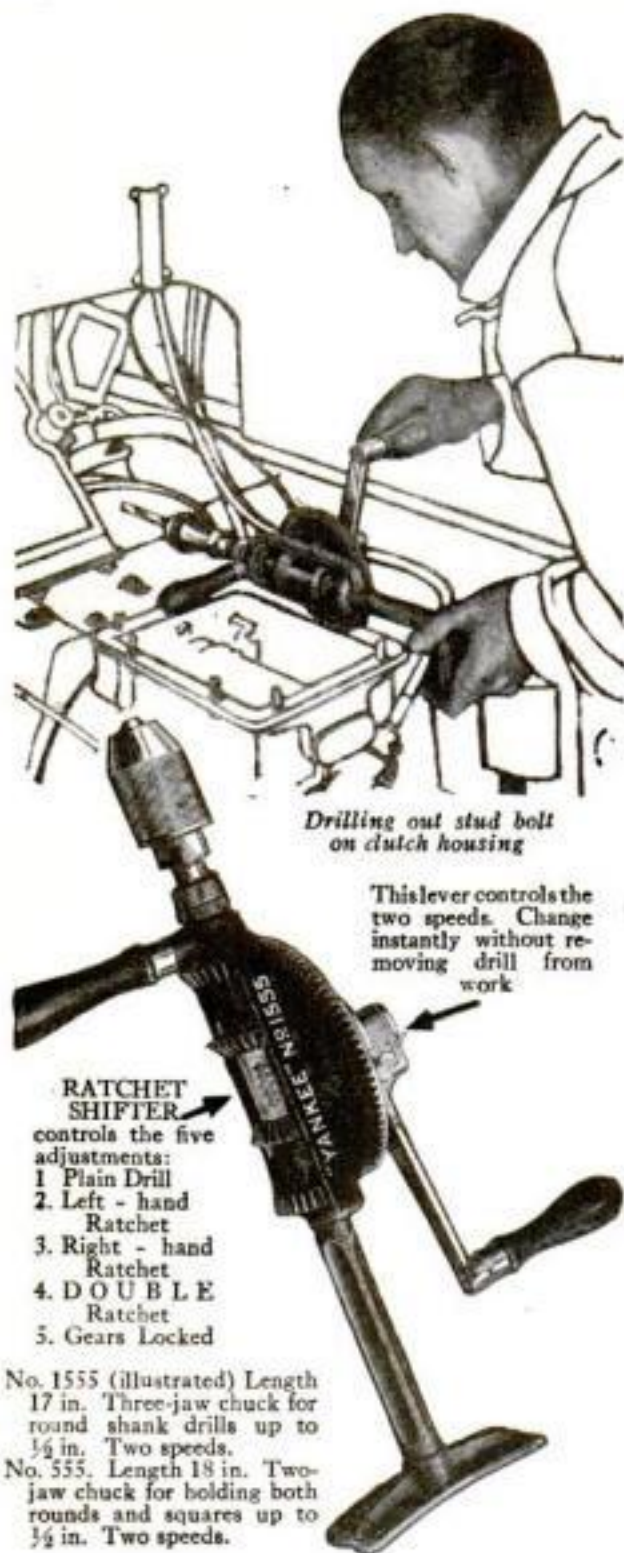


Fig. 6. Laying the deck

A signalling mast is an improvement and not a difficult thing to make. It may either be stepped on the fore deck or on the cabin top, the former being the better if practical. It is as well to have light wire stays from near the top to each side for carrying your flag and at night the white light. The mast will also support your aerial, if you have a radio set.

Your boat is now ready for the engine and propeller, and such light equipment as is needed. And now for the first cruise!



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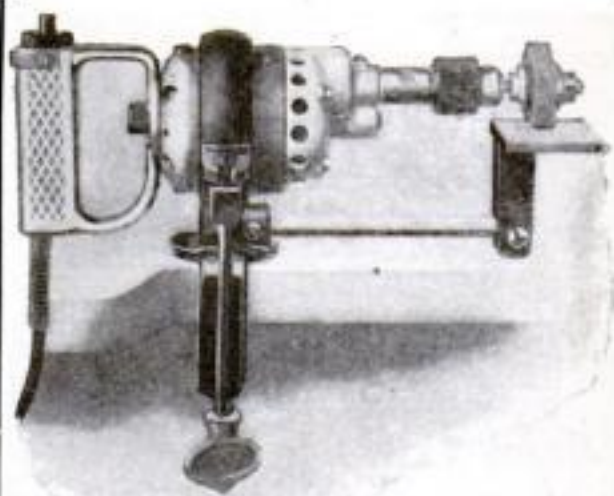
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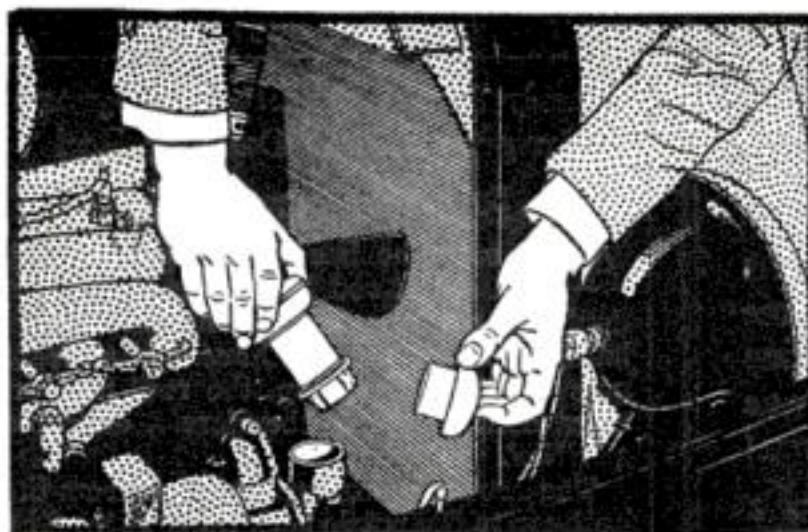
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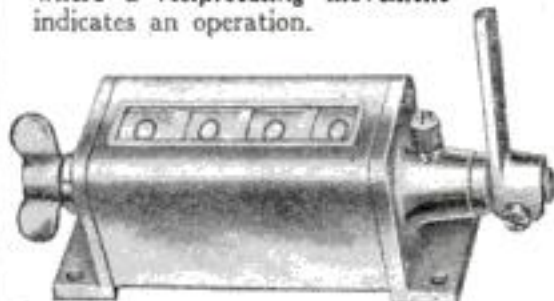
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The Hand Tally illustrated below is used for counting anything from number of people attending a ball game, to number of packages in an inventory.

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THE HOME WORKSHOP

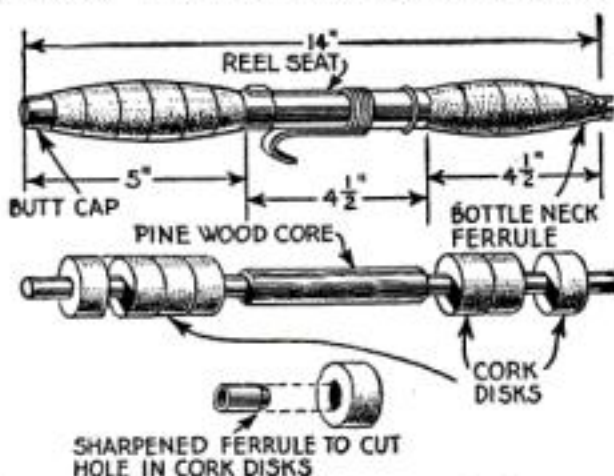
Easily Made Double Handgrasp Improves Bait-Casting Rod

By Robert Page Lincoln

ANY one who has done much casting with a bait rod knows the value of a double handgrasp. In reeling the lure or handling a fish, the left hand instinctively goes forward to grasp the rod, and an extra cork grasp is therefore a desirable addition.

The double handgrasp measures from the butt cap to the bottle neck taper 14 in. The cork disks or washers are trimmed slightly larger than their finished size and holes are cut into them with an old ferrule filed sharp. The cork should be of good grade and free from holes, the pieces being 1 in. thick or less.

The corks are put in place one at a time, after the edges of the holes and the sides of the corks have been coated with rod cement. When the forward grasp is filled,



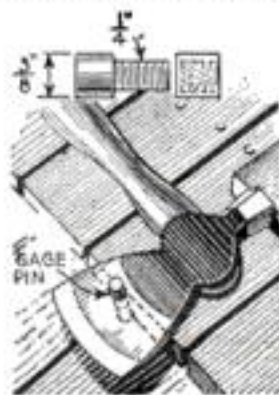
How the double handgrasp is built up from sections of cork

make a foundation of pine to slip over the rod for the reel seat. This should be 1/4 in. or more shorter than the reel seat, so that the first cork of the forward grasp can be trimmed and worked down into the reel seat. Not a little care is needed in shaping the wooden piece, because it must fit exactly the under side of the reel seat. It is then slipped into place and cemented to the cork.

The reel seat is next put in place; then the corks of the back grasp are put on, and both grasps are trimmed with sandpaper to the correct shape. Three screws are used for fastening the butt cap, two for the reel side, and three for the bottle neck ferrule.

Spacing Gage Fastens Directly to Shingling Hatchet

THE shingling device illustrated, which I made for a carpenter friend, has saved him much time in laying shingles. It consists of a locating pin made in two pieces, as shown, to fit through a hole in the blade of the shingling hatchet. By placing the pin against the edge of the row of shingles already in place, the head of the hatchet gives the location for the row of shingles to be laid above without the necessity of measuring.—J. A.



Handy shingling gage

Stillman Taylor, sporting writer, tells next month how to build a floating camp



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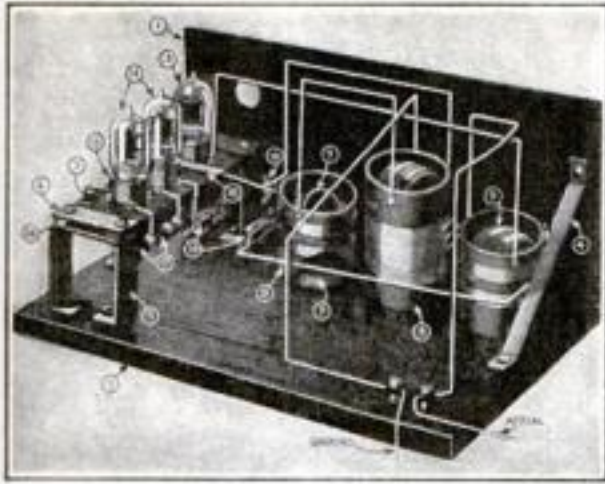
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P. S. July

THE HOME WORKSHOP

Making a Simple Box Kite and Kite Reel

THIS box kite, which is of Japanese origin, is made in the simplest possible fashion of eight sticks and some cambric or paper. Four of the sticks are 20 in. long and four 12 in., all of them either $\frac{1}{4}$ in. square, $\frac{3}{8}$ in. square, or $\frac{1}{4}$ by $\frac{3}{8}$ in.

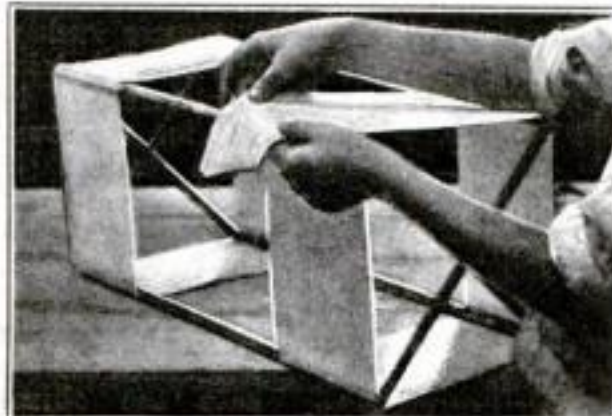
Two crosses are made by nailing the smaller pieces together in pairs with thin brads. It is best to make holes first with a thin drill, bradawl, or hot needle. The crosses are then nailed to the ends of the four long sticks. Considerable care is necessary not to weaken the joints by splitting the wood. String can be used to reinforce the frame, if it appears to be necessary.



Nailing the frame together

Two strips of brightly colored cambric or paper, about 3 ft. long and 5 in. wide, are fastened to the sticks and the ends are glued together. The bellyband can be adjusted by trial; usually the best results are obtained by fastening the upper end about $4\frac{1}{2}$ in. below the end of one of the long sticks.

Flying this kite is much more fun if a kite reel is used. The reel is simply a magnet wire or other large spool with two large flanges or end pieces sawed from very thin wood and glued to the ends. The spool is



Strips of bright cambric are glued to the frame and then the bellyband is added



fastened in a small box by means of an axle made from a dowel or other round rod.

Where one end of the shaft passes through a hole in the side of the box, it is held in place by a washer and a cotter pin or a nail run through a hole in the shaft. To the other end, outside the box, is fastened a wooden crank, as shown, by means

(Continued on page 94)

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THE HOME WORKSHOP

Making a Simple Box Kite

(Continued from page 93)

of a screw or nail, a washer being placed between the crank and the box.

A short length of dowel is fastened with glue and a brad in a hole in the outside end of the crank, so that

a spool can be slipped over it to form a handle. This spool is held on its spindle with a washer and cotter pin and should turn freely.

Two school straps run through slots cut at the back of the box are for fastening the reel to the body.—C. M. G.



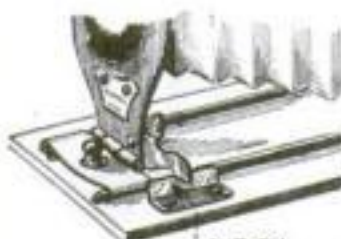
The completed kite reel

Taking Large "Closeup" Photos with a Folding Camera

BY USING a portrait lens and extending the bellows of a single lens camera a little more than usual, it is possible to take photographs of small objects and documents so that the image fills practically the entire plate or film. Shortly after the war I photographed many honorable discharges for soldier friends in this way.

All that it was necessary to do was to file off a portion of the stop on the bed of the camera to allow the lens to be drawn over to the edge of the bed. In this position, and with the addition of a portrait lens, it is possible to take photos at a distance of 13 1/2 in. from the camera, as opposed to the 3 ft. that is ordinarily required when a portrait lens is used at the 8-ft. focusing point.

For objects or documents too large to photograph at 13 1/2 in., it is necessary to focus the camera before the film is inserted, and to measure the distance between the object and the lens. In cameras such as



CUT ON DOTTED LINE

Stop is filed off to allow bellows to be extended

mine, which takes a picture 2 1/4 by 3 1/4 in., a ground glass cannot be used; therefore I use a piece of bond paper, oiled with a light machine oil, on which to find the focus and locate the object. The object is then left where it is, the position of the camera is marked, the film is inserted, and the picture taken at the distance found correct.

I secured the best results by using two 60-watt lamps located about 2 ft. from the object, and in front of and about 2 ft. apart, one on each side of the camera the right of the lens. These lights were backed with reflectors of white cardboard. An exposure of four minutes with the smallest stop gives a cleancut, sharp picture, but the time varies with conditions.—M. C. EVERETT, Chicago, Ill.

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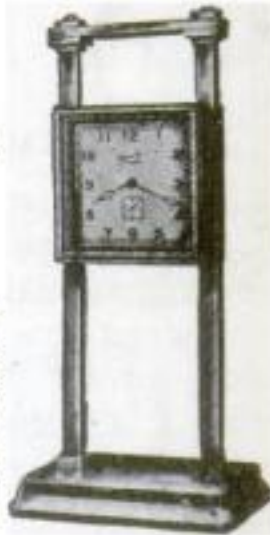
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THE HOME WORKSHOP

Framework of Pipe Supports Simple Portable Garage

By R. C. Liebe

THE garage question is a serious proposition for many men who do not own their own home or who, like the writer, are compelled by their business to move from place to place. After building five garages in as many towns or locations, I designed two knock-down or portable garages and constructed the one illustrated.

The framework consists of ¾-in. galvanized pipe and fittings. There are three separate frames, one on each end and one in the middle. The pipe is thoroughly

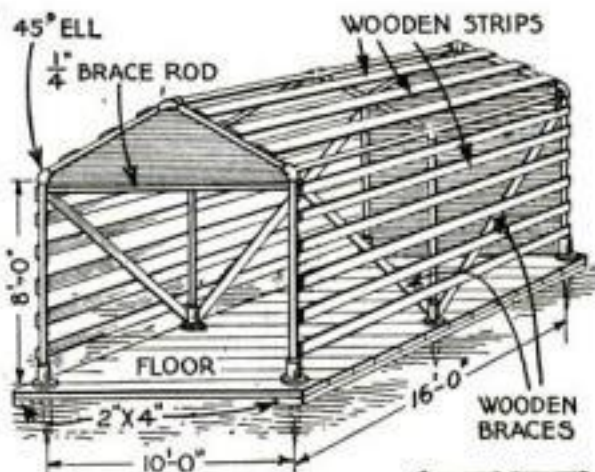


Diagram of garage frame
and two types of doors
made with pipe and fittings

braced with wooden strips bolted on with stove bolts.

Holes 3/16 in. in diameter are drilled in the posts and roof sections about 14 in. apart throughout, and 4-in. dressed wooden strips are bolted on to form the sheathing. The roof is covered with heavy tar paper, and the sides and ends with 8-oz. tenting. The duck is then given a coat of auto top dressing, so that the color of the garage throughout is black.

With a helper I can make this garage ready for my car in several hours, and it takes even less time to pull it down and pack it up in bundles for shipment.

The piping required for a garage 10 ft. wide, 8 ft. high and 16 ft. long consists of six posts 8 ft. long, six "rafters" 6 ft. long, and nine 45-degree ells. For a Ford car the garage can be 1 ft. less both in length and width.

The diagram is practically self explanatory. The builder can brace the garage as much as he thinks necessary to meet weather conditions. Iron spikes driven into the ends of the posts and then set into the ground serve to anchor the structure. If a wooden floor is to be used, a sufficient number of sleepers should be laid to support the heavy planking.

Each of the three pipe frames is held together by a ¼-in. rod bolted through the posts and tightened from the outside. Canvas curtains can be hung on this rod to form the cheapest kind of door, or one of the other doors shown can be used. These are pipe frames covered with canvas or wooden strips and tar paper or both.

A VARNISHED floor can be kept in good condition by rubbing it at intervals of every two or three months with an inexpensive mixture of equal parts of sweet oil, turpentine and vinegar. Apply the cleanser with a soft rag or cotton waste.

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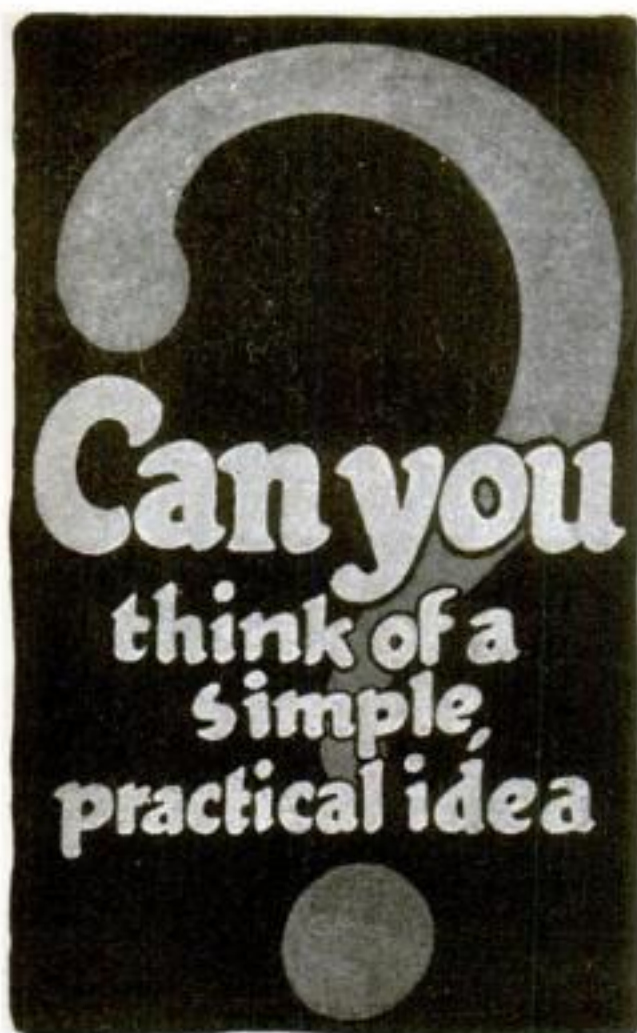
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Pioneer Cavemen Who Invented Civilization

(Continued from page 35)

ture, the adventure which is still going on. He was ready to begin trying to control his world.

This is an enterprise that no other animal has ever attempted. The evolutionary history of most creatures falls into one single story, the story of how the conditions of life in the world have shaped the living thing so that it fits into them, of how the giraffe got a long neck so that he could eat leaves off the tops of trees, or of how the tiger developed his stripes so that he would be invisible among the striped shade and sunlight of the long grass.

This is the history of how the world and the conditions of heat and cold and sunlight and animal competition that exist in it have affected the forms of life.

Man has shared this history. He, too, has been affected by the world. That is how his body was forged for him in the long ages of evolution, as we have told in previous chapters of this serial. This is how he was induced, in the end, to invent cooperation and live together in civilized communities. This part of man's history we conclude in this chapter of our story.

Man Turns Tables on Nature

We still have to tell the greatest and most inspiring part of the story of man—the part in which he begins to turn the tables on the world and to change it instead of being changed by it.

The story of man's adventure in the world is like that of a castaway on a desert island. In the beginning the island changes the castaway. It hardens his muscles and toughens his feet and tans his skin. But when these things have been done, after the castaway has yielded for a while to the pressure of his island, it becomes the castaway's turn. He begins to change the island. He cuts down the trees that he does not want and plants those that he does. He exterminates the kinds of beasts that he does not like. He dams a stream of water and changes its course so that it will run past his dooryard. He makes over the island to suit his idea of what a home-like island should be.

And man, cast away on this little speck of an earth, perhaps an exile from some larger civilization that he does not remember, is making over his earth, slowly but surely, so that it shall be more like the place in which he wants to live.

For Further Reading

THE best account of the New Stone Age is Tyler, "The New Stone Age in Northern Europe," referred to in the previous chapter of this serial. The best general history of the world, including all the essentials of the origin of civilization, is H. G. Wells' "The Outline of History" (The Macmillan Co., New York, 1921). On the beginnings of the ancient civilizations see J. L. Myers' "The Dawn of History" (Henry Holt & Co., New York, 1911). The best scientific summary of what we know about early Egypt, Babylonia, and Crete is "The Ancient History of the Near East," by H. R. Hall (Methuen & Co., London, 1920).

NEXT month—The Origin of Speech and Writing.

How man preserved the record of his achievements, passing down his acquired knowledge from generation to generation by means of pictures, writings, and the spoken word.

One of the most important and fascinating chapters of "The Story of Man and His World," in the August issue.

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How Much Do You Know about Science?

FOLLOWING are the correct answers to the 30 questions on fundamental facts of science printed on page 64 of this issue. Grade yourself 10 points for each question answered correctly and see how near you come to a 100 per cent score for each classification.

The Story of the Stars

1. The latest and best estimate—that of Dr. Harlow Shapley of Harvard College—is that the group of all the stars that we can see in a telescope and that astronomers call the galaxy, is about 300,000 light-years from side to side. This means about 1,764,000,000,000,000,000 miles. It is possible that some of the nebulae are outside of this and therefore even farther away.
2. The air is not perfectly transparent. It makes light waver a little, just as things outside seem to waver when we look through a window pane of imperfect glass. This wavering of the light from the stars make them seem to go out altogether from moment to moment. That is, they twinkle.
3. Perhaps a few of the stars are like the earth, but most of them are not. There really are two kinds of stars—dwarfs and giants. The dwarf stars are about the same size as our sun. They are fairly dense, like a liquid or a very highly compressed gas. The giant stars, on the other hand, are made of very thin, highly rarefied gases. Most of them are far thinner even than air.
4. This is an optical illusion. The stars are so far away that we can see them only as points of light; not as round or as any other definite shape. The pointed appearance is a mistake of our eye.
5. We may be quite sure that the future cannot be foretold by the stars. Scientists do not believe that it can and no one has ever been able to prove the contrary.
6. The moon, as it moves around the earth, happens to get exactly between us and the sun, causing an eclipse of the sun.
7. Because it is hot. Sunlight is the same thing as the light from a piece of white hot metal except that it is on such a tremendously larger scale.
8. Because it reflects back to us the sunlight that falls on it, just as though it were a mirror.
9. The moon seems to be made of rocks about like those of the earth.
10. The earth and everything on it would be burnt up. Probably there would be so much heat produced by the smash that even the rocks would be turned into gas.

The Story of the Earth

1. The best proof is that ships can sail around it. There are many other proofs. The earth's shadow on the moon is round, as seen in eclipses. The curvature of the earth can actually be measured by delicate surveying instruments. Wireless signals can be sent around the earth and back to the sending station.
2. No. The speed at which earthquake shocks pass through the earth from one side to the other, proves that the earth is rigid all the way through, even more rigid than steel. It may be that the inside of the earth is hot but is kept from melting by the tremendous pressure of the miles of rock above.
3. Because the water rolls the stones around all the time and wears off their corners by knocking them together.
4. Yes. Man and monkey are descended from the same ancestral stock, though the human branch and the monkey branch separated many millions of years ago. It is not scientific to say that man is descended from monkeys.
5. The greatest known depth of the sea
(Turn to page 102)

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How Much Do You Know about Science?

(Continued from page 101)

is a little over six miles or 32,088 feet. This deepest place is in the Pacific Ocean near the Philippine Islands.

6. Four fifths of the air is nitrogen gas. One fifth of it is oxygen gas. The gases are not combined chemically; they are merely mixed together. Air also contains several gases that are present in very small quantity. The chief one of these is argon.

7. The air in one place gets heated, usually because the sun shines for a while on the land underneath it. This heated air rises, making a partial vacuum. Air from all around rushes in to fill the vacuum. This makes wind.

8. The little water drops in the clouds are made by a lot of water molecules condensing together. If this goes on long enough, the drops get so large that they fall down as rain.

9. When the air is cold enough, the water molecules, collected together, form a little crystal of ice instead of a liquid raindrop. These ice crystals are the snowflakes.

10. Because clear air allows more heat to be lost from the ground and from the layers of air next to the ground. Clouds act as a sort of blanket and keep the heat in so that the temperature does not fall quite so low.

Every-Day Chemistry

1. Certain substances, like coal, can combine chemically with the oxygen of the air. This is a chemical reaction producing heat. The heat makes the fire.

2. Incomplete burning of the gasoline or oil in the cylinder. There is carbon in gasoline and in all motor oils. Some particles of carbon are left unburned after the explosion in the cylinder and are thrown out as smoke.

3. Iron combines chemically with the oxygen of the air and with water vapor, which also may come from the air. This makes a compound called hydrated oxid of iron. This compound is red. It is the rust.

4. Dip a piece of cloth in a strong solution of soda lye. Wool will be eaten away; cotton will not be affected.

5. Milk turns sour because a certain kind of germ grows in it, the germ called the lactic acid bacterium. This bacterium converts the sugar of the milk into an acid substance called lactic acid, which has a very sour taste.

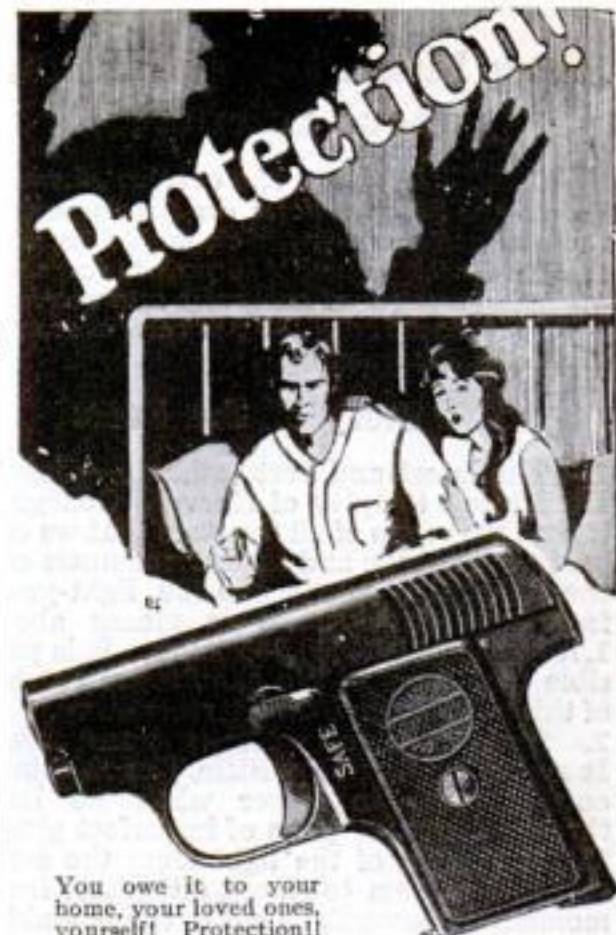
6. The yeast used in making bread is the same little living plant that is used in making alcohol. Bread dough contains a little sugar derived from the starch of the flour and the yeast converts this sugar into alcohol. At the same time it produces a lot of little bubbles of carbon dioxide gas. It is these bubbles that make the bread rise.

7. Strictly speaking, bluing does not bleach clothes at all, it merely turns them a little blue. Washed clothes are likely to be a little yellow. Any painter will tell you that blue tends to neutralize yellow. So the small amount of blue tint added by the bluing makes the clothes appear whiter than before.

8. No. Thunderstorms have no effect on milk at all. The common idea that they have, probably comes from the fact that a summer thunderstorm is likely to come up toward the end of a very hot day. It is the hot day that sours the milk, not the storm.

9. Salt absorbs water from damp air. The surface of each little grain becomes moist. This makes the grains stick together.

10. The air contains a small amount of sulphur gases, derived, usually, from the sulphur contained as an impurity in coal and other fuels. Silver has a great affinity for sulphur. It takes up the sulphur gases from the air and forms a black compound called sulphid of silver.



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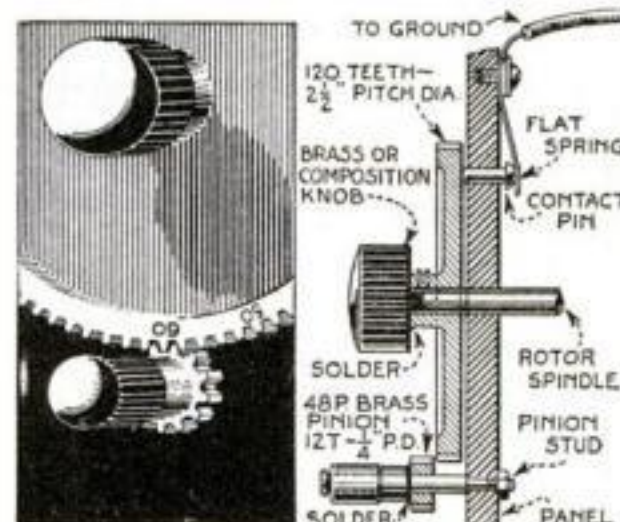
THE HOME WORKSHOP

Brass Gear Serves as Dial

(Continued from page 74)

The Vernier attachment consists of a 12-tooth brass pinion of the same pitch as the "dial," with a pitch diameter of $\frac{1}{4}$ in., and to this pinion a small knurled knob is soldered. The whole unit is free to slide on a shouldered stud anchored to the panel.

Many amateurs do not favor the use of metal dials, but if the dials are grounded, they serve as a "shield" and are equal to, if not better than, composition dials. The grounding is accomplished by means of a brass pin free to move in a hole in the panel and forced by a flat spring into "brush" contact with the back of the gear. The screw serves to hold the spring in place



After the large knob is used for rough tuning, the pinion is pushed into mesh to obtain Vernier adjustments

and provides an attachment for the ground wire, the other end of which is connected with the ground terminal of the set.

The Vernier pinion is slid in and out of mesh with the dial, so that rough adjustments may be made with the dial knob and the finer adjustments with the Vernier. Since the gear has 120 teeth and the pinion only 12, the ratio between them is 10 to one, so that if the pinion is moved one degree, the motion transmitted to the gear causes it to move only one tenth of a degree.

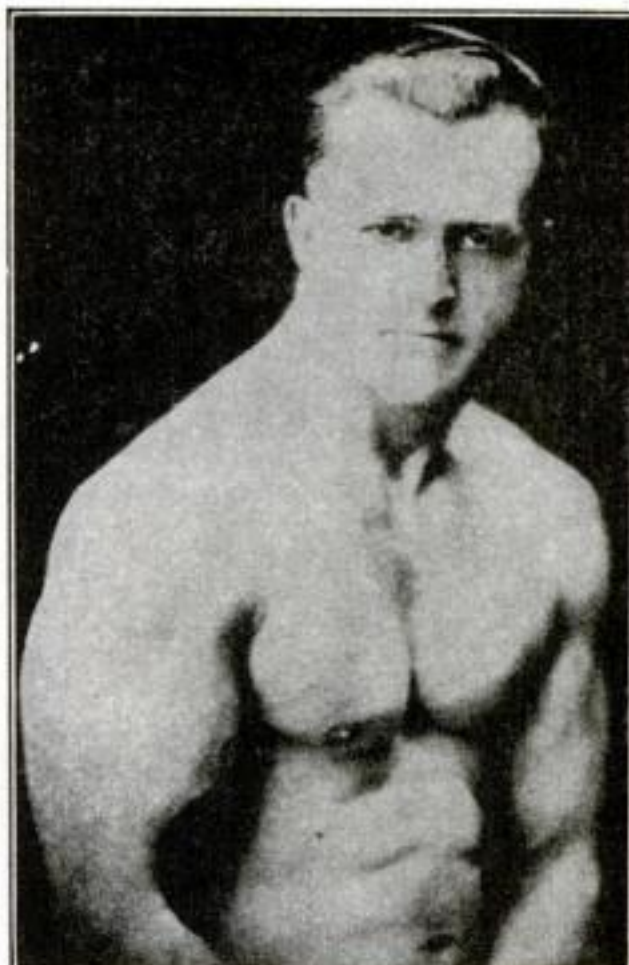
To give this unusual dial a finished appearance, it can be coated with aluminum paint and the numeral impressions filled with black drawing ink.

The gear and pinion combined should not cost more than a dollar and are obtainable from gear manufacturers or from dealers carrying modelmaker's supplies.—C. M. WILCOX, Torrington, Conn.

Improving Rotor Bearings

AN ENJOYABLE radio program coming through the writer's receiving set was turned into a barnyard chorus on several occasions because of the poor contact between the rotor spindle and its bearings. The bearings were of the common type—strips of brass, each with a bearing hole and a spring slot. After the instrument had been used a short time, the bearings, as so often happens, failed to grip positively.

Brass eyelets or short lengths of brass tubing with a hole the same or a trifle larger than the rotor spindles were slotted with a hacksaw and soldered to the bearing strips. These increase the bearing surfaces so that good contact is insured.—W. M.



EARLE E. LIEDERMAN
as he is today

How Do You Look in a Bathing Suit?

The good old swimming days are here. Oh boy! But it's great to rip off the old shirt, into your suit and take the splash. But what a shock to some of the poor girls when they see their heroes come out with flat chests and skinny arms instead of the robust frames they expected to see.

You Can't Fool Them

Don't try to make excuses. You should have knobs on your arms like a baseball. A fine protector you would make, when you can't even fight your own battles. What are you going to do? She is going to find you out.

Look Your Best

It's not too late. I can save you yet. It means hard work and plenty of it, but think of the results. In just 30 days I am going to add one full inch to your biceps. Yes, and two inches on your chest in the same length of time. But that's only a starter. I am going to broaden out those shoulders and put real pep into your old backbone. You will have a spring to your step and a flash to your eye, showing you to be a real, live man. Before summer is past you won't recognize your former self. You will have a physique to be really proud of. This is no idle talk, fellows. I don't promise these things, I guarantee them. Come on and make me prove it.

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It contains forty-three full-page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. All I ask is 10 cents to cover the cost of wrapping and mailing and it is yours to keep. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send today—right now, before you turn this page.

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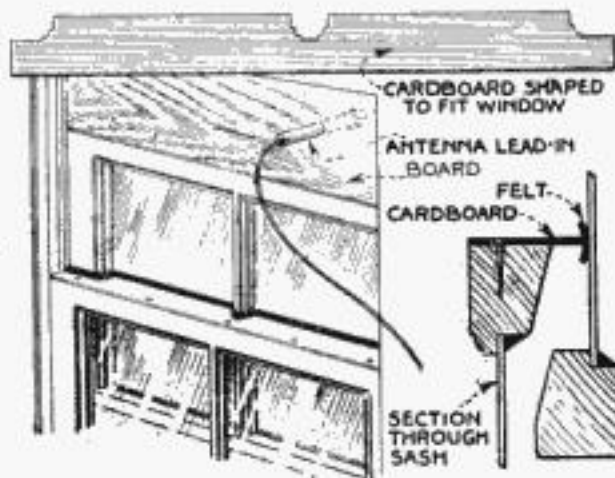
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THE HOME WORKSHOP

Preventing a Draft from Radio Lead-in Windows

USUALLY the simplest method of bringing an aerial lead-in indoors is through some part of the window. A narrow board is often placed either at the bottom or top of the window, as shown, and a hole bored in it for the porcelain insulator.

The objection to this method is that the meeting rails of the sash no longer come together and therefore a considerable draft can enter the room. To prevent this, cut



The open space between the meeting rails is filled with a felt-edged strip of cardboard, wallboard, or wood

out a piece of wallboard, stiff cardboard, or even thin wood to the shape of the sash, as shown, and glue a length of felt weather strip to the edge. The strip is then pushed firmly against the glass and fastened with tacks to the meeting rail of the lower sash.—FRANK W. HARTH.

Preventing Storage Battery Noises

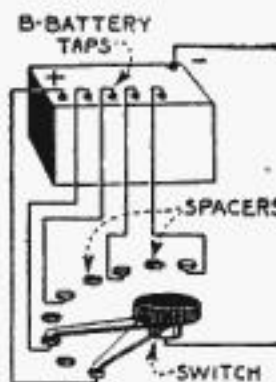
SOMETIMES bubbling and irregular action of a storage battery will cause noises in a radio receiver. These often can be stopped by shaking up the storage battery.

Spacers Prevent Short Circuiting Radio B Battery Switch

TO CHANGE rapidly the voltage of a radio B battery, it is convenient to use a switch with several contacts. Usually five are sufficient, since 16½ volts is about the lowest point at which a gas detector bulb functions satisfactorily, and 22½ volts the highest, the space between being divided into intervals of 1½ volts.

There is, however, a disadvantage in mounting the contact points of the switch successively, because if the switch arm is so wide or the contacts so close together that the end of the blade touches two points at the same time, the cell between the points will be short circuited. The switch arm, if left in such a position for any length of time, will ruin the short circuited cell, as many radio fans have discovered to their loss.

To avoid this, extra points can be inserted between the active points of the switch, as shown. These serve merely as spacers and no current can flow when the switch arm rests upon one of them.—H. F.



Blind switch points safeguard the battery cells

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CHARGES "A" "B" "C" RADIO & AUTO STORAGE BATTERIES at HOME Overnight, for A Few Cents from Any 100 to 120 Volt Cycle A.C. Lamp Socket. F-F CHARGERS made Battery Charging Popular. A—Recharges 6 Volts Up to 120 Volts of 150 Loudspeaker Storage Batteries in Series inductively At Home Overnight. Disconnecting Batteries & Multiple Connections Unnecessary. Infusible Rectifying Brushes Maintain Constant Efficiency Uninterruptedly. Complete Portable AUTOMATIC. AMMETER eliminates Guess Work. No Skill Required. Nothing Like It Made. Lasts Lifetime. Screen Plug Insulation Socket. Snap Clips on Battery Terminals. Turned On & Battery Charged in Morning. Charged Batteries Mean Fewer Expensive Replacements. In Home Use To Top Up An F-F CHARGER than To Buy a New One. INSIST ON THE F-F CHARGER. Buildily A Master of the Art in Types. Thousands Sold Make Possible These POPULAR PRICES:

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No previous musical knowledge necessary—no "boreome"
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OUR METHOD SIMPLE AND POSITIVE

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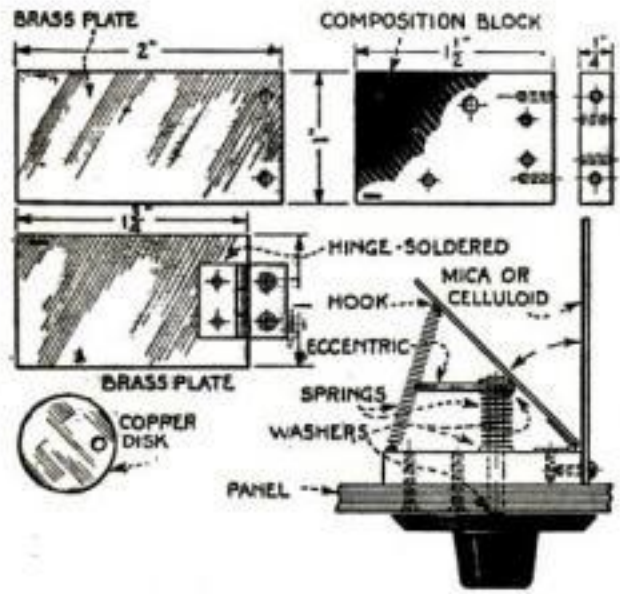
THE HOME WORKSHOP

Easily Made Vernier Condenser
Tunes Radio Set Sharply

IN THESE days of extreme radio interference, perhaps the most useful addition to the average set is one or more Vernier condensers. The type illustrated can easily be constructed and is quite free from the effects of body capacity.

Two brass plates of heavy gage are needed. One should be 1 3/4 in. long and the other 2 in. long, both being 1 in. wide. A piece of insulating composition or hard rubber is also needed, 1/4 by 1 by 1 1/2 in.

A hinge is soldered to the shorter brass plate and fastened to the insulating block with 6/32 screws, after the block has been drilled and tapped to take them. Holes are drilled in the larger plate, as shown, and a thin piece of mica or celluloid is attached



Fine adjustments in tuning are made possible by this small, panel-mounted condenser of the "book" type

to one face of the plate with shellac. A piece of photographic film will serve.

The easiest way to fasten the mica or celluloid is to heat the plate until flake shellac will melt into an even coating when rubbed over it. The mica or celluloid should then be laid on and the plate put under pressure on a flat surface until the shellac is hard. The plate is then fastened to one end of the block with two screws.

The capacity of the condenser is varied by moving the hinged plate toward or away from the fixed plate. This is accomplished by turning a cam made from a brass or copper disk about the size of a penny, drilled at one side and fastened to the shaft so that the movement will be eccentric.

Washers placed as shown will insure the shaft turning smoothly and the spring provides sufficient tension to prevent the pressure of the movable plate from rotating the shaft. Another spring is fastened between the plate and the block, care being taken that it does not interfere with the movement of the cam.

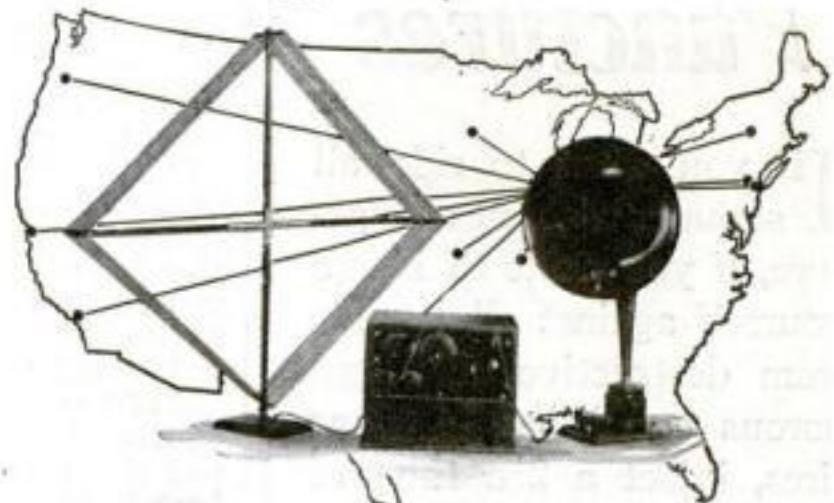
One wire lead should be soldered to the fixed plate and another to the movable plate or to the spring connecting with it, and these leads should be connected around the large condenser. The Vernier is then in parallel with the large condenser and permits extremely delicate adjustments to be made in varying the capacity of the circuit.—H. H. HOUCK, Rochester, N. Y.

THE radio beginner will do well to mount the set he is making on a plain board first and use it for some time before placing it in a cabinet. It is then easy to experiment with the set until it works well.

Range, Volume, Portability
With a Single Tube!



Erla radio frequency transformers cover a waveband of 200 to 800 meters. Types AB1, 2, 3, \$4. Reflex \$5



Erla Reflex Transformers
Assure This Result

Vacation time holds new and untold pleasure when you tune in with Duo-Reflex, the most powerful single-tube circuit ever built. Through a loud speaker, it brings in all but the most distant stations; and with headphones it ranges from coast to coast. Its light weight, less than fifty pounds, with dry cells, makes it ideal for camping trips or tours.

Responsible for the amazing efficiency of this circuit, and the secret of its power, is the Erla radio frequency reflex transformer. Overcoming completely the high capacitance of domestic vacuum tubes, and with lowest inherent capacitance, it provides maximum amplification without distortion.

Ask your dealer for free Erla Bulletin No. 13, giving diagrams and notes for building the Duo-Reflex circuit. Or write,



Erla Bezels, in 1" and 1 1/2" sizes, have telescoping rim that fits any 1/4" to 3/4" panel. Nickel or black enamel. 20c



Direct comparative tests reveal sharply the superior accuracy of Erla condensers. Eleven sizes, 35c to \$1 each

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Ford Top Recoverings, \$5.45 up to \$11; Chevrolet or Overland 4, \$7.95 to \$15.00. All other Cars \$9.95 to \$20.00, with plate glass lights. Our Leather Cushion and Back Upholstering covers up unsightly Cushions and Backs, and wears like Buck Skin, from \$2.00 to \$5.00 each. Side Curtains that open with doors \$11.90 up. Seat Covers \$3.15 up. Quality the best and guaranteed to fit. Printed instructions given how to apply. Send for samples. Prices above include delivery at your door. Eastern orders shipped from Ohio.
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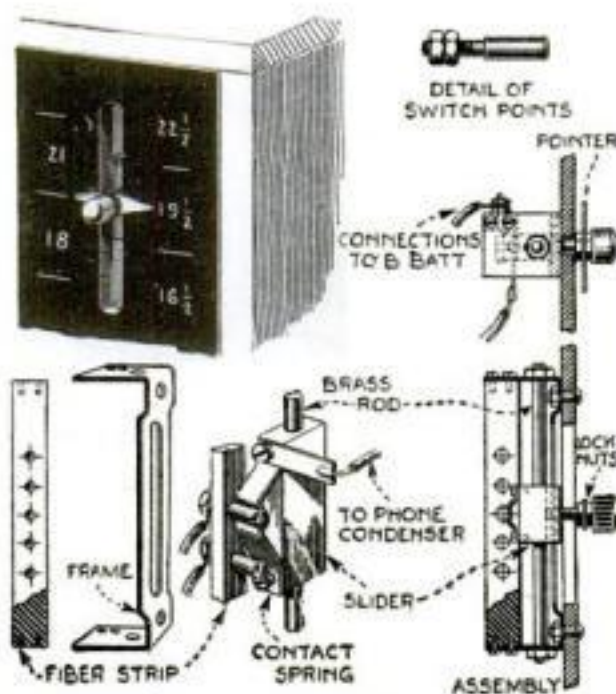
THE HOME WORKSHOP

Unique Switch Gives Distinction to Homemade Receiving Set

IF YOU wish something original for one or more of the switches on your radio set, the simple sliding switch mechanism illustrated will be found a neat, serviceable, and distinctive arrangement.

I use it to vary the plate voltage current for the B battery, but it would serve equally well, of course, for the taps of a variocoupler or other variable inductance. Although not as easy to install as the common radial type switch, it gives one the satisfaction of having a radio device that is a trifle out of the ordinary.

A slider with a contact spring is arranged on a brass rod behind the panel in such a way that it can be moved by means of a knob into engagement with switch points. A brass strip soldered to the spring and projecting to one side about 1 in., carries the



The switch points of this unusual sliding radio switch are concealed behind the panel

current to the phone condenser through a flexible wire, and the terminals of the B battery are connected with the switch points. These are mounted one below the other on a fiber, hard rubber, or composition strip.

A strip of sheet brass about 1/16 in. thick is bent up, as shown, to form the frame, and a slot is provided for the slider, as well as holes for the screws to attach the strip for the switch points. The slider itself is made of fiber, and the contact spring is a light gage of spring brass.

A brass rod is mounted on the frame by means of terminal nuts to act as a guide for the slider, which is kept from turning by the guide slot in the frame.

The slider is manipulated from the front of the panel by moving a brass screw with a knurled edge. This knob is provided with a pointer held in position with locknuts.

Graduations engraved on both sides of the panel slot and filled with white paint give the finishing touch to this novel switch.—A. M. C.

A POTENTIOMETER will often increase both the selectivity and sensitivity of a receiver. In order to connect a potentiometer into the circuit, take out the wire leading from the negative of the B battery to the A battery and connect the negative of the B battery with the sliding member of the potentiometer. One end of the resistance element is then connected with the negative of the storage battery and the other end with its positive terminal.

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a pleasure. Gives you gas anywhere, everywhere, in any stove or range. Everybody knows gas means cleaner, cheaper cooking and a cooler kitchen.

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30-Day Trial The Instant-gas Oil Burner makes its own gas from coal oil (kerosene) at one-sixth the cost of city gas. Much cheaper than coal or wood. Because it can be regulated the Instant-gas Oil Burner Cooks and Bakes Better than coal or wood in the same stove. No coal or wood to carry, no ashes, no chopping, shoveling or starting of fires. Greatest woman-saver in the world.

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Our big volume business enables us to sell brand new Cord tires at lowest prices. Don't miss this Sale. Every Cord guaranteed first quality and new. Order your season's supply now and cut your tire cost in two. Thousands of steady customers getting 10,000 Miles full mileage and you, too, can get 10,000 Miles

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30x3	\$5.95	\$1.05	34x4	\$11.75	\$1.65
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32x3.5	7.25	1.30	32x4.5	14.40	2.10
31x4	9.90	1.40	34x4.5	14.90	2.15
32x4	10.65	1.45	35x4.5	15.40	2.25
33x4	11.30	1.50	35x5	20.00	2.50

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Just send your name, address and finger size, and we will send you this beautiful genuine diamond, 14K solid gold ring on approval. Send no money; pay no C. O. D. Merely accept the ring and wear it a week. Then decide—either return the ring and call the deal closed, or keep it and send only \$3.75 a month until our cut price of \$38.75 is paid. (Regular \$60.00 value.)

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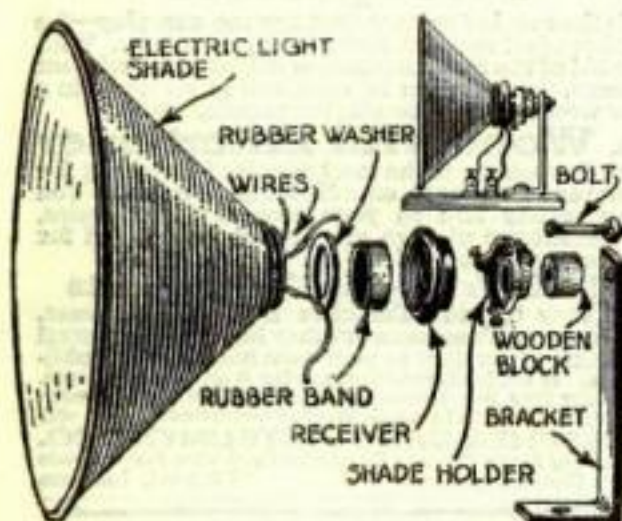
THE HOME WORKSHOP

Electric Light Shade Serves as Horn for Loudspeaker

ALL that is necessary to make a very cheap yet neat looking loudspeaker is a 1500-ohm telephone receiver, a common tin electric-light shade, a brass shade holder, and a few odds and ends to be found in almost any home workshop.

On a wooden base $\frac{1}{4}$ by 4 by 8 in., screw a support made from a brass strip $\frac{1}{8}$ by $\frac{1}{2}$ by 7 in., drilled with a $\frac{3}{16}$ -in. hole $\frac{1}{2}$ in. from each end, and bend as shown, 1 in. from one end. Prepare a cylindrical block 1 in. in diameter and 1 in. long with a $\frac{3}{16}$ -in. hole through the center and clamp it to the adjustable ring of the shade holder.

Fasten the block and shade holder to the top of the standard with a $1\frac{1}{2}$ -in. bolt. It



The parts of the lampshade loudspeaker in the order in which they are put together, with wooden bracket

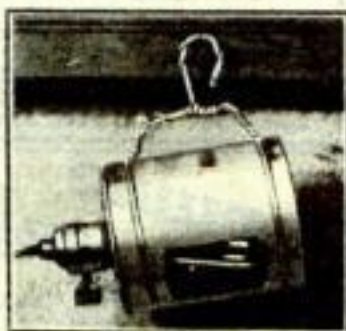
will be found that the setscrew end of the shade holder will fit over the top of the telephone, the setscrews holding it fast.

Place a rubber washer between the face of the telephone cap and the small end of the shade, slip a wide rubber band over the joint, and fasten the shade firmly by wiring it to the setscrews in the shade holder. Flexible leads from the telephone are brought down to binding posts on the base.—GEORGE FREDERICK, Washington, D. C.

Coffee Can Makes an Adjustable Trouble Light Protector

THIS trouble light protector is made from a 1-lb. coffee can and a length of bailing wire. It protects the lamp, saves the worker's eyes from all glare, and at the same time serves as a very effective reflector.

The wire handle, being movable, can be set at any point on the circumference and the protector can be held or hung up with the light turned as required. It also will stand on its flat base on the workbench or other support. This flexibility makes it even more desirable, to my mind, than the usual wire lamp guard.—R. A. FRANKLIN, Rochester, Minn.



A VACATION radio set of unique design and with only one control will be described in the Home Workshop next month.

Down goes the price!

BOXING \$1.97

Jiu-Jitsu

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Think of it! For only \$1.97 you can now have the famous Marshall Stillman Course—the same identical \$5.00 course by which Marshall Stillman has taught boxing, jiu-jitsu and wrestling to over thirty thousand men! You can have it on ten-day trial—send no money.

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With the course you get a Free History of Sixty-nine Famous Boxers, with their pictures and "inside" stories about them.



SEND NO MONEY. Simply fill in and mail the coupon. When you have the course in your hands, deposit 97 cents (plus the actual postage) with the postman. Then examine the course for ten days—try it thoroughly. At the end of ten days, either send us the small balance of \$1.00 in final payment, or return the course and we'll send your deposit back. Marshall Stillman Association, Dept. 1123-F, 42nd Street and Madison Avenue, New York.

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You may send me on approval the Marshall Stillman Course. I will deposit 97 cents (plus the actual postage) with the postman, with the understanding that if, after ten days, I wish to return the course I may do so and my money will be instantly refunded. If I keep the course, I am simply to send you \$1.00 in final payment.

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Without one penny of advance payment let us place in your hands to see, to examine, to inspect, to admire, to approve, a real masterpiece in watch creation. A Watch which passes the most rigid inspection and measures up to the exacting requirements of the great Santa Fe Railway System, and other great American trunk lines.

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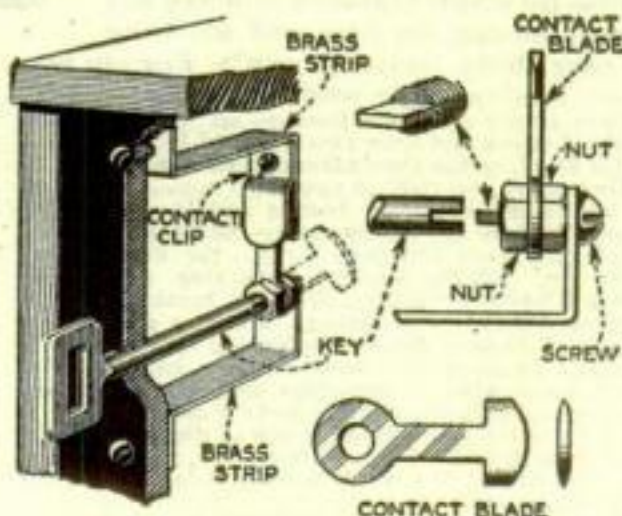
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Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada.

THE HOME WORKSHOP

Simple Lock Prevents Tampering with Radio Receiving Set

THIS lock makes it possible to break the filament circuit of a radio receiving set in such a way that it can be closed again only with the key. Simple in construction, it can be made with materials found in every radio fan's workshop.

The key is round stock with a slot cut in the end to fit the end of a screw that is filed down as shown. A contact blade is pivoted



A removable key operates a concealed switch that opens and closes the filament circuit

by means of this special screw on a brass strip bent as indicated and fastened to the back of the panel. A similar brass strip carries a contact clip so arranged that when the contact blade is turned up, it will enter the clip and close the circuit.

Only three holes have to be drilled in the panel to install this lock. If the cabinet has an easily opened top or back, it is necessary either to place the lock in a position where it cannot be reached without damaging some of the instruments and connections, or it must be boxed in solidly.—A. C. SELETZKY, Catonsville, Md.



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Two Year Guarantee
Spirit tubes protected by glass lenses. Broken glass replaced within 2 years. Glass containers removable.

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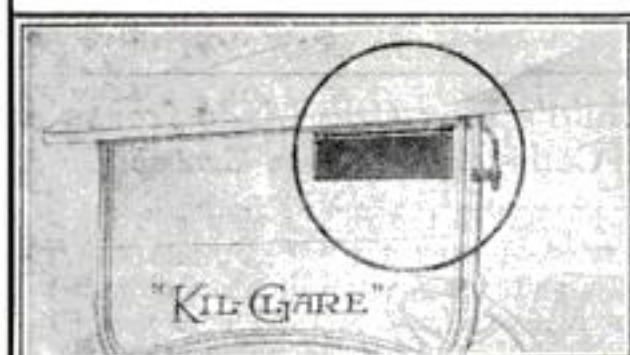
CAR OWNERS WANTED!

To use and introduce the greatest improvement in Inner Tubes since autos were invented. Air gauge in valve stem of every Tube shows at a glance through the Unbreakable Transparent Valve Cover amount of air in tires.



AIR-GAGE Heavy Duty Tubes

—sell on sight to almost every car owner because they save trouble, time, worry and expense. Add one-third to life of tires. Paul salesmen make big profits selling direct to car owners. Our million dollar factory can use 500 more salesmen at once. Experience not necessary. The Illustrated Free Book tells how the Paul Plan will start you in this big money-making business without capital. Write for Free Book Today. THE PAUL RUBBER CO., Dept. 51, Salisbury, N.C.



Safety for Night Drivers

KILLS the blinding glare of on-coming headlights. Does not obstruct the driver's view. Easily attached to wind-shield. Swings quickly into position and as quickly out of the way. Simple and well made. Equally as effective against a bright sun. Price \$3.50—the cheapest kind of insurance against night accidents due to the other fellow's headlights. By parcel post prepaid on receipt of remittance with order. Give make of car, closed or open.

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Limited stock, electric motors, rebuilt by our own experts and fully guaranteed, offered subject to prior sale, f. o. b. Chicago at the following extremely low prices:

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A C—	\$10.00	\$12.00	\$13.00	\$24.00	\$37.00
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* Repulsion induction type.

Also a few larger sizes. Send Cash with order. Money back if not satisfied.

Northwestern Electric Co.

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STUART'S PLAPAO-PADS are different from the truss, being mechanical-chemical applicators made self-adhesive purposely to hold the distended muscles securely in place. No straps, buckles or springs attached—cannot slip, so cannot chafe or press against the pubic bone. Thousands have successfully treated themselves at home without hindrance from work—no cast. **Grand Prix** oblique cases conquered. **Grand Prix** Soft as velvet—easy to apply—Inexpensive. Awarded Gold Medal and Grand Prix. Process of recovery is natural, so after wards no further use for trusses. We prove it by sending Trial of Plapao absolutely **FREE**. Write name on Coupon and send **TODAY**.

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Return mail will bring Free Trial Plapao.



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and quarters sewed together, with rear fasteners, welts and tanks, complete. Anybody can put it on. Give name, year, model number of your car. Catalog **FREE**. Agents wanted.

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The Shipshape Home

How To Do the Odd Jobs

Removing Tile Paper

WHEN the home worker attempts to re-paper a bathroom with the imitation tile paper so frequently used, he usually finds it next to impossible to remove the old paper. That is because the paper has a coat of water-resisting varnish.

The first step in removing it, therefore, is to take off the varnish. This can be done easily with strong household ammonia. The fumes are unpleasant, but the ammonia will take off the varnish, and then the paper can be soaked off with warm water to which a small amount of ammonia has been added.—R. T.

Filling Floor Cracks

BEFORE refinishing a floor, fill the cracks with a crack and crevice filler made by a reliable paint manufacturer or with a crack filler prepared by soaking white blotting paper in water, squeezing out the excess water, and kneading glue size and whiting into the paper until the mass is putty-like in consistency. Dry colors can be used to tint any crack filler to match the color of the floor.

When using a commercial crack filler, it is advisable first to paint the edges of the cracks with linseed oil. After the crack filler has set for about 24 hours, sandpaper the floor.—A. S. U.

Rubbing Varnish

IN ORDER to refinish furniture and to make repaired parts match old work, the home worker sometimes finds it necessary to duplicate rubbed varnish effects. This is not at all difficult if the varnish used is of a hard drying variety suitable for rubbing.

It is safer for the amateur to rub the varnish after it is thoroughly dry with oil and powdered pumice stone, although professional finishers use water with the pumice. Linseed oil cut with a little turpentine is rubbed over the work, and then the pumice is applied on a piece of felt or rag moistened with the same oil.

As in sandpapering, rubbing should be done in the direction of the grain. Angles and moldings should be cleaned out with a cloth wrapped around the end of a small stick.—E. H.

Repairing Flush Tanks

WHEN water runs continually from a flush tank, it is usually because the rubber ball that closes the outlet pipe has become soft and flabby or the wires connecting it with the handle require adjustment. Find out which it is and either replace the ball with another of the same size or bend the wires to work properly.

If the copper float ball leaks and allows the water to flow into the tank all the time, it can be replaced in an emergency with a pint flask or bottle. Unscrew the ball from the rod, make a hole in the flask's cork a trifle smaller than the rod, give the cork a coat of shellac, screw it on the rod, and then push the bottle on the cork. This will make a serviceable repair until the copper ball is mended.

He found it in Valparaiso

Then he headed north and found it up near the "jumping-off place"

No matter what part of the world you may find yourself in, few things make you feel more at home than to walk into a store and discover your favorite smoking tobacco for sale.

With your favorite tobacco in your favorite pipe, life is worth living in almost any corner of the globe.

This thought was inspired by the following letter from Mr. Bromley, an Edgeworth smoker from Fort Wayne, Ind.:

LARUS & BROTHER CO.,
Richmond, Va.
Gentlemen:

In some of your advertisements from time to time I have noticed letters from different users of Edgeworth Smoking Tobacco and I wondered if anyone ever had a more varied experience than I have had.

When in Valparaiso, South America, I could get it; and when I was as far north as a man could well go without going to the "jumping-off place," I could get Edgeworth Ready-Rubbed.

I have an old briar that I have had for ten years and it never had a crumb of any but Edgeworth in it.

If that isn't going some, "you tell me."

Yours truly,

(Signed) W. E. BROMLEY.

If Mr. Bromley makes frequent skips from continent to continent, his record of keeping all tobacco but Edgeworth out of his briar is indeed noteworthy.



But as a rule Edgeworth smokers, wherever they are, generally manage to find a way to get Edgeworth, for they don't feel as if they are really smoking unless the tobacco comes from a little blue can.

If you are not an Edgeworth smoker, send your name and address to Larus & Brother Company, 59 South 21st Street, Richmond, Va.

You will receive almost immediately free samples of both Edgeworth Plug Slice and Ready-Rubbed. Then you can judge for yourself what you think about this tobacco that so many smokers claim gives complete pipe-satisfaction.

If you will include the name and address of your regular tobacco dealer, your courtesy will be appreciated.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

2000 lbs. Hydraulic Pressure

5000 More Driver AGENTS WANTED

Guaranteed SALARY or Commissions! \$50 to \$200 A WEEK

STOP wasting your time on hard-to-sell SMALL PROFIT lines. What bigger opportunity for making money can you find than selling the ONLY auto lubricating system which uses heavy oil under 2000 lbs. pressure! Grease and oil cups, greasing systems, now out of date. "Only 100% lubrication" say engineers of the SAAL Heavy Oil System.

AS EASY TO USE AS AN OIL CAN

SAAL HEAVY OIL System

100% lubrication

\$5.00 for FORD, OVERLAND, CHEVROLET, STAR, GRAY

\$8.00 for ALL OTHER CARS

100% lubrication

42 Fittings included—fit all CARS

Saves Repairs, Depreciation! Agents! GET YOURS FREE!

Less than half price of other systems, but pays for itself quick in repair bills and depreciation saved. Lubricates steering, shackles, entire chassis. So easy to use you actually use it! Makes lubricating a white-collar job, and you get service-station results. Cheapest insurance the car-owner can buy!

30 Days' FREE TRIAL Offer!

Agents without selling experience are selling 9 out of 10 calls simply by following our instructions. FREE TRIAL and money-back offer gets them all. No investment, no waiting for your profits, no delivering or collecting. Sell dealers, garages, motorists.

DEALERS! Leading auto-makers have adopted "SAALS" as standard equipment. Standard Oil Co., Western Electric Co., and many similar corporations have equipped every truck with "SAALS." Coupon brings biggest profit-making opportunity of 1923. Mail it today!

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\$25 A DAY Selling Shirts

Large shirt manufacturer wants agents to sell complete line of shirts, pajamas, and nightshirts direct to wearer. Advertised brand—exclusive patterns—easy to sell. No experience or capital required. Entirely new proposition. Write for free samples. Madison Shirt Co., 503 Broadway, N.Y.C.

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Send for Bulletin U-102
V-DE-CO RADIO MFG. CO. Dept. O, Asbury Park, N. J.

THE HOME WORKSHOP

Child's Play Crib Made from Collapsible Onion Crates

IN MAKING the child's play crib illustrated, I used three collapsible onion crates and some scrap lumber obtained from a sawmill. The total cost was 60 cents for material. Since making the first, I have built four others for friends and received \$3.50 for each.

The following material is required for one crib: 4 pieces 1½ by 1½ by 22 in. for corner posts; 2 pieces 1½ by ¾ by 23 in. for top end rails; 2 pieces 1½ by ¾ by 41½ in. for top side rails; 2 pieces 1½ by ¾ by 23 in. for bottom end rails; 2 pieces 1½ by ¾ by 41½ for bottom side rails; 26 pieces 1 by ½ by 18½ in. from onion crates for the uprights; ½-in. boards from old boxes to make the flooring, and 4 casters.

Mortises ½ in. deep are cut in the rails to take the uprights. Mortises are also cut in the posts to take the rails. The tenons on the bottom end rails are first fastened into the proper mortises in the corner posts with cabinetmaker's glue and then the uprights are put in place and the top end rails added. Each end is then drawn together with clamps, wire, or rope, or nailed to the floor until the glue is dry.

The side rails and the uprights are next glued together. The sides and ends are connected with dry mortise-and-tenon joint held with screws. This permits taking the crib apart for shipment and storage. A ½ by ½-in. strip is fastened all around the bottom rails, ½ in. below their upper edge, to support the ½-in. flooring. Casters are added and the whole stained and varnished or enameled.—A. J. LOCHER.

Cheaply Made Hoist Saves Labor in the Home

MANY back-breaking jobs can be lightened by the simple hoist. It is made from a 25-cent clothesline pulley, attached by an S-hook to 3 ft. of 1-in. angle iron. A hole in the center of the angle iron takes a 7/16-in. pivot bolt. At the end opposite the pulley is a length of 1-in. angle iron bolted with a short ¾-in. bolt at right angles to the main arm. This short piece butts against the porch ceiling when the hoist is being used. At other times the position of the hoist is as indicated by the dotted line.—S. HILLS, Torrington, Conn.

THREE or four lengths of dental floss or silk thread twisted together and waxed will form a strong and flexible string for restringing bead necklaces.—B. FOX.

This One



ATC3-ELE-EPPC

THE HOME WORKSHOP

A Simple Horizontal Bar Serves for Stretching Exercises

HAVE you ever noticed how much better a good stretch makes you feel? The blood tingles to your fingertips and your head seems clearer. Stretching exercises are, indeed, considered among the most valuable, because they temporarily relieve the pressure on the spinal cushions and set the blood in vigorous circulation.



Hanging relaxed from a homemade bar

My family has been reaping the benefit of stretching exercises for several years by using a horizontal bar set up in a narrow hall. The hardwood bar, which is about 1 3/8 in. in diameter and 3 ft. long, is supported at each end in a semicircular recess cut in a wooden block 1 by 3 by 12 in. The two brackets are fastened to the walls opposite each other to support the bar

about 7 ft. 8 in. above the floor, and are screwed solidly through the lath and plaster into the studs with 3-in. screws (see illustration above).

The bar is held in the recesses by two metal clamps, obtained at a hardware store. If an expansive bit is at hand, a hole can be bored in each of the blocks and the clamps done away with.

I don't recommend attempting to chin the bar unless you are athletically inclined. Just hang completely relaxed and when fingers and arms are tired, drop down and rest.

If an additional exercise is desired, try arching the back with shoulders back, chest out, and draw up the feet as far as possible, relaxing slowly to first position.—R. W. THOMPSON, New York.

Summer Features in the August Home Workshop

A WEALTH of "how to make" material will appear in the Home Workshop Department of the August POPULAR SCIENCE MONTHLY.

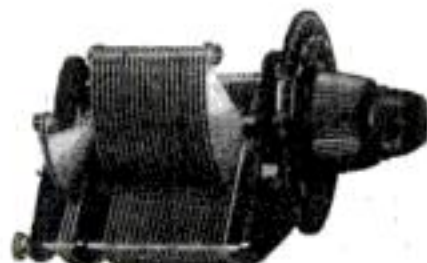
One article will give details for the ideal vacation radio outfit—a one-control, dry-cell set that fits a 7 by 8 by 10 in. cabinet. Another will tell how to build rustic furniture for the camp.

Other stories contain constructional details of a unique sailing raft for swimmers, a small ornamental fountain, a power-driven lawnmower, and a floating camp.

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No. 605 Variable Condenser with Vernier

HUNDREDS of testimonial letters tell us of the superiority of our head sets in actual comparative tests, barring none.

Increased volume, unusual clarity, long distance receiving, are some of the reasons for the rapid growing popularity of Kellogg head sets.

Your receiving set is not complete without a Kellogg No. 69A head set. A few minutes listening-in will convince you of its merits.

Have you seen a Kellogg variable condenser? It is a real condenser in every sense of the word. Takes the uncertainty out of tuning.

Note the size and construction of the plates, the method of mounting the Bakelite ends. All have a direct bearing on your satisfaction with radio.

Improve the reception and tuning of your set with a Kellogg variable condenser.

Kellogg radio parts are of the highest grade throughout and the workmanship is of the best, giving radio fans a product that produces definite results.

The best is the cheapest in the long run. Why experiment.

Built and guaranteed by

KELLOGG SWITCHBOARD & SUPPLY COMPANY

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Adjusted to the Second 21 Ruby and Sapphire Jewels
Adjusted to Temperature 25 Year Gold Strata Case
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Invite your friends tonight. Surprise them with a real concert or dance.

The wonderful new Dictogrand will create the illusion that the artists are in the very room with you. Just go to your dealer's and hear this remarkable, clear-toned instrument. Take it home and plug in for the finest entertainment you've ever known. You don't need extra batteries. Like all the other famous Dictograph Products, the Dictogrand is guaranteed for one year.

If your dealer hasn't the DICTOGRAND in stock, write to us direct.

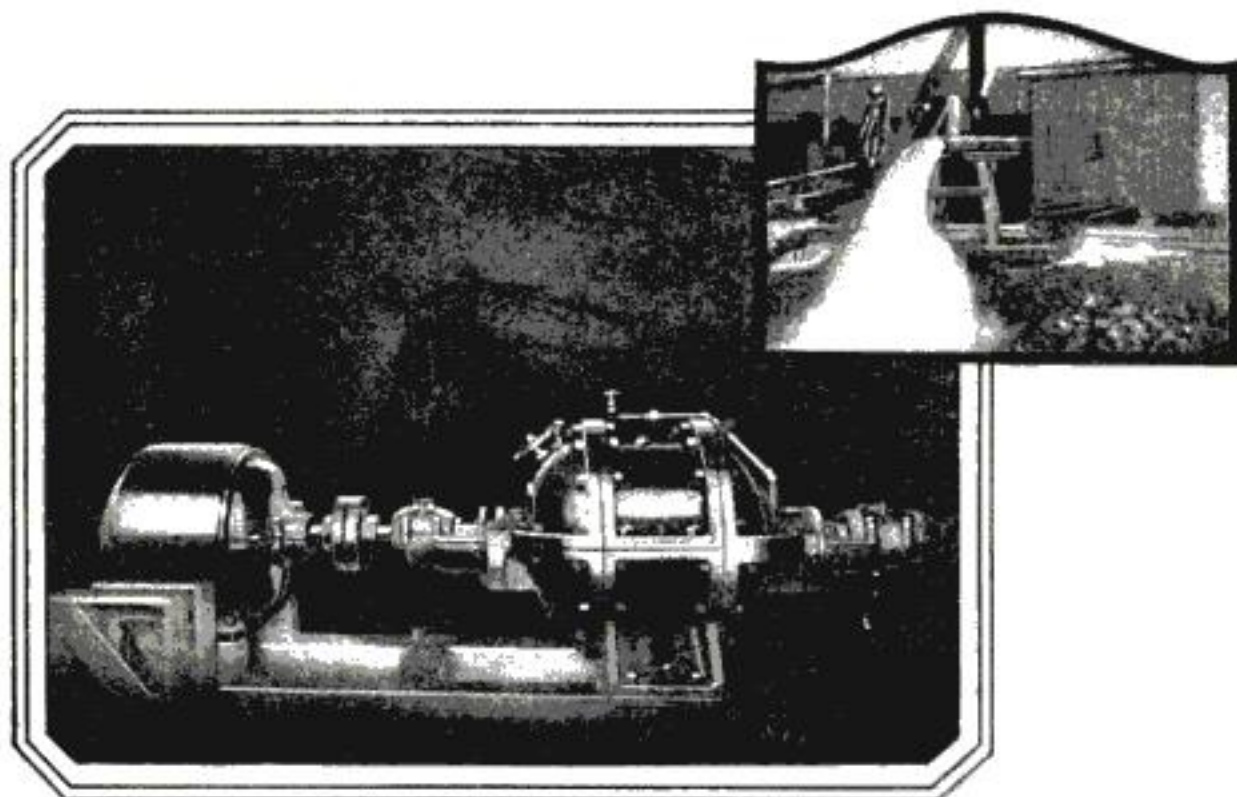
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\$28.50

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In subways, coal mines, railway tunnels, the pumps are always ready, and the lives of millions of people are kept safe by this General Electric invention—a sentinel who never sleeps.

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These tires are made by one of the largest standard tire makers in the U. S. and are of the very best quality. Our tires are so good and made by such a well known maker that after your first order you will buy repeatedly from us. When you see the quality and the brand you will be convinced. All are cord tires except 30x3 1/2 size.

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Using the MAGNAVOX

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While the Radio enthusiast constantly strives to better his receiving equipment, Magnavox Reproducers and Power Amplifiers are units which no other apparatus can replace.

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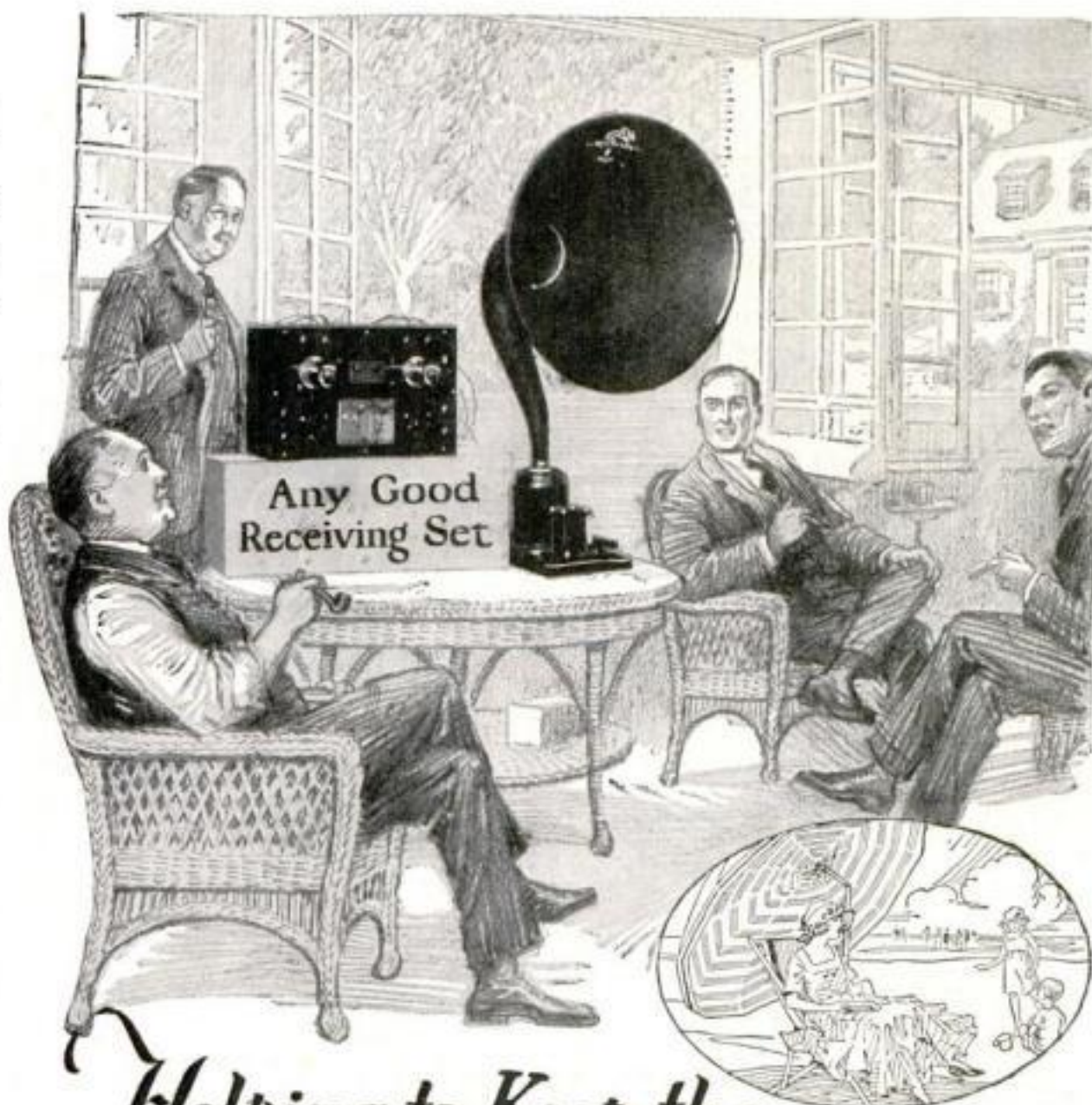
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The Proper Finish Will Make Your Furniture Harmonize



Small odd pieces of modern furniture add greatly to the attractiveness of every home. You, yourself, can easily make them for your family. There is no particular trick to constructing porch swings, tables, telephone sets, etc.

The furniture, woodwork and floors of your home can be made to harmonize if a little taste is used in finishing them. You can easily refinish dingy, shabby, scratched wood. Our method involves practically no expense. All you need is a little time—a brush—and **JOHNSON'S WOOD DYE.**

Johnson's Wood Dye is very easy to apply—it goes on easily and quickly, without a lap or a streak. It penetrates deeply, bringing out the beauty of the grain without raising it—dries in four hours and does not rub off or smudge.



JOHNSON'S WOOD DYE

FREE—This Book on Home Beautifying

This Book tells how to finish wood in artistic stained and enameled effects. Gives practical suggestions on making your home artistic, cheery and inviting. Tells just what materials to use and how to apply them. Includes color card—gives covering capacities, etc. Use coupon below.



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JOHNSON'S WOOD DYE is made in fourteen standard shades—a few of which are:

- | | |
|--------------------|----------------|
| 129 Dark Mahogany | 126 Light Oak |
| 127 Brown Mahogany | 123 Dark Oak |
| 140 Early English | 110 Bog Oak |
| 131 Walnut | 124 Golden Oak |
| 125 Mission Oak | |

All shades may be easily lightened, darkened or intermixed. Full directions on every label.

If you are building or remodeling you should have our book on Wood Finishing. It is chock full of valuable information. We will gladly send it free and postpaid. Use coupon at left.

